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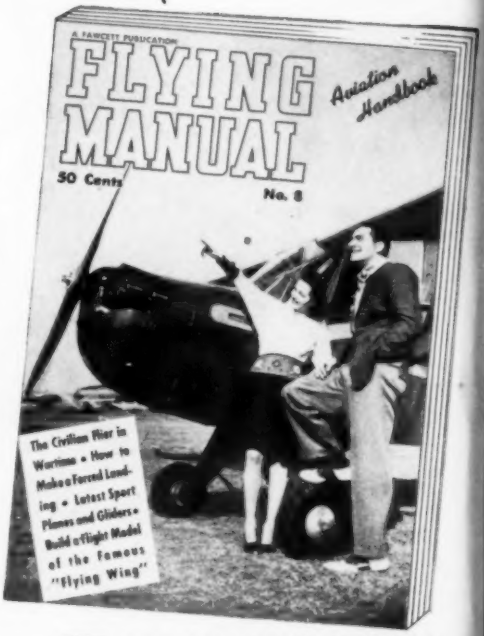
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JUNE 1942

Volume XXVIII Number 2

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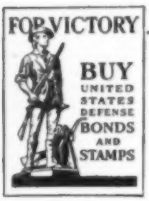

WILLY LEY

Even to scientists, the tatzelwurm, gierfugl, hoatzin, okapi, and the quagga sounded like names dreamed up by a baby just learning to talk, until Willy Ley rescued them from neglect last year in *The Lungfish and the Unicorn*, his delightful and sound book (incidentally, his first in English) on the screwballs of the zoological world; in it he makes out a convincing scientific case for story-book beasts like dragons, basilisks, unicorns, and sea serpents. In contrast to that fanciful subject-matter, Mr. Ley in recent months has been writing on the grim topic of war weapons in a daily column for the newspaper PM. These articles and his best-selling book of last fall, *Bombs and Bombing*, have been so widely hailed as definitive discussions that MECHANIX ILLUSTRATED asked him to devise and describe the weapon which in his estimation could stop the tank terror. You'll find his feasible and encouraging suggestion for the United States on page 56 of this issue.

NEXT MONTH

Igor Sikorsky, one of the most famous names in aviation, tells you some startling things about that weirdest of all flying contraptions, the helicopter.

You'll learn about a mystery invention which may wipe out the torpedo menace, too.

And don't fail to read Flying Officer Jack Scherer's thrilling story, "Bombardier," written by a man on active duty in the R.C.A.F.

Be sure to get your July MI, on sale June 1.

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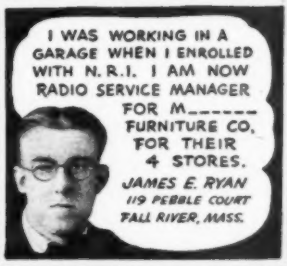

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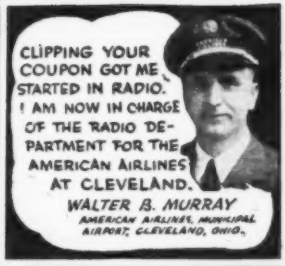

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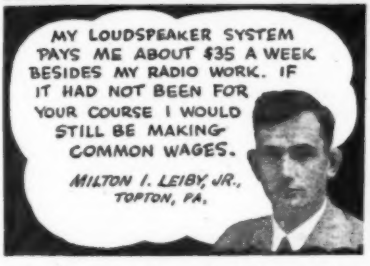

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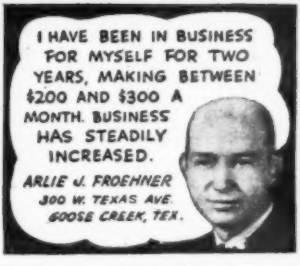

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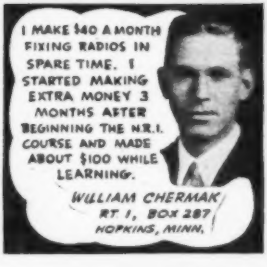

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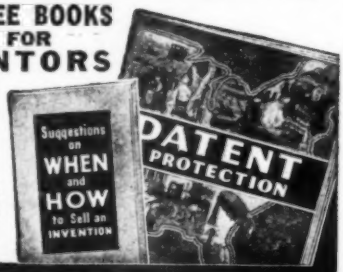

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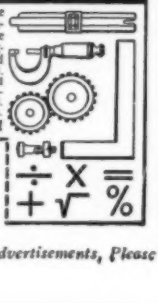

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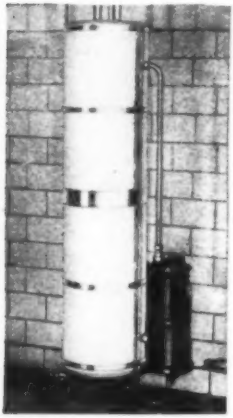
NEW PRODUCTS AND INVENTIONS

LATEST HOME AND SHOP DEVICES • POPULAR PATENT IDEAS

GOSSIP OF DEFENSE AND INVENTORS

by Morton Leese

Inventors receiving actions on their applications from the Patent Office should not fail to respond in time. Failure to make a timely answer may result in the application being held abandoned for lack of prosecution. The normal time in which a response must be made is six months. However, a shorter time limit may be set by the Patent Examiner. Unless notified in writing that response is required in less than six months, the maximum period of six months is allowed for response. The time for reply, when a time less than six months has been set, will be extended only for good and sufficient cause. Any request for such extension must be filed on or before the day on which the answer is due.



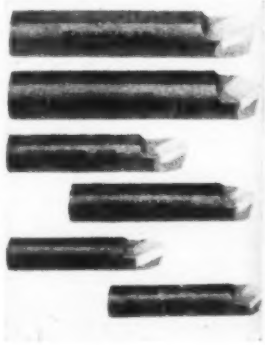
Both range boilers and basement hot water tanks can derive greater economy of operation through the use of some form of heat insulation as a covering material. The insulating jacket shown on this hot water tank is made of Fiberglas. It is said to effect savings in hot water heating costs. It has recently been made available through department stores and hardware stores. Plumbing supply dealers also handle it. Fiberglas is said to be a very effective insulating material, well adapted to use on installations of this type, on range boilers or hot water tanks.

* * *

"General Information Concerning Patents" is a pamphlet which can be obtained free of charge simply by writing to The Commissioner of Patents, Washington, D. C. Although the Rules of Practice are not given, some of the Rules are included in condensed form. The pamphlet includes typical forms for use in preparing patent applications. Illustrative applications, including a description of a mechanical drawing of an invention, are shown. Information of value to inventors can be obtained from this source.

* * *

A new series of boring tools recently announced, are shown at the right. They have round shanks and a 12 degree positive back rake to compensate for the negative effect of the tool being held at a height one half the height of the shank above center. They are supplied in common shank sizes, the tolerance on the round shanks being plus .000" minus .001". Styles are included for use in 30 degree boring bars and also for 45 degree boring bars. The tools are tipped either for general steel machining or very hard for extra precision work.



The Sterilamp, a newly patented ultraviolet ray lamp, finds extensive use in the Tenderay process

This new improved type low-cost power feed drill press has recently been announced. The power feed unit operates directly off the bottom drive of the motor, and makes possible a wide range of feeds, from .0010 to .016 per revolution of spindle in the slow speed drill presses, and from .0005 to .009 in high speed ones. Many features are included.

New Products

[*Continued from preceding page*]

of treating meat. The lamp creates a sterile atmosphere and shortens the time heretofore needed for tenderizing meat. The lamp is also used in air-conditioning and in treating dishes and the like to make them sanitary. Domestic refrigerators with the lamps may also be made available. The lamp was granted patent No. 2,258,765.

* * *

Seeking means for keeping rubber from getting old is almost as much a preoccupation of present-day chemists as the quest for the elixir of youth was for their alchemical ancestors. Newest effort along this line is represented in a process just patented by Joseph R. Ingram of the Monsanto Chemical Company, in which a coal tar derivative, indene, plays the principal part.

Aging in rubber consists primarily in its combining with oxygen of the air. This makes it stiff, deprives it of elasticity, finally produces breakdown—even as you and I. To ward off this fatal oxidation, compounds known as anti-oxidants are added in processing the rubber. Indene, in the form of compounds with formaldehyde and related chemicals, is claimed to be superior in this respect.

Mr. Ingram has been granted two patents, Nos. 2,274,367 and 2,274,368, on his process and its products. Rights have been assigned to the Monsanto firm.

* * *

An anti-aircraft projectile which the inventor terms an "aerial mine" is the subject of patent 2,274,264, issued to Erich Bickel of Baden, Switzerland. It consists of a case containing a small charge of high explosive, suspended by a long wire from a parachute. Fired into the air in numbers, in advance of an enemy plane, the wires are expected to snag on the speeding craft, which will be destroyed by the explosive charges.

The essential feature of Herr Bickel's invention lies in the mode of packing the parts. Heaviest part of the projectile is the forward section, on which the wire is reeled, with the parachute packed in the tapering nose. At the predetermined moment, a small powder charge in the base pushes this, and the explosive mine behind it, out of the case, shrapnel-fashion.

The mine, being relatively light, lags in flight, unreeling the wire from the faster-flying, heavier forward section. When all the wire has been payed out, it straightens, jerking the parachute out of the nose, which flies on empty. The mine is now afloat in the air, ready for business.

This invention appears to be an elaboration of an idea first suggested during World War I by Prof. R. W. Wood of the Johns Hopkins University. Prof. Wood's proposal was simply for steel wires or tapes, to tangle hostile planes and pull them down, launched from anti-aircraft shell.

[*Continued on page* 150]

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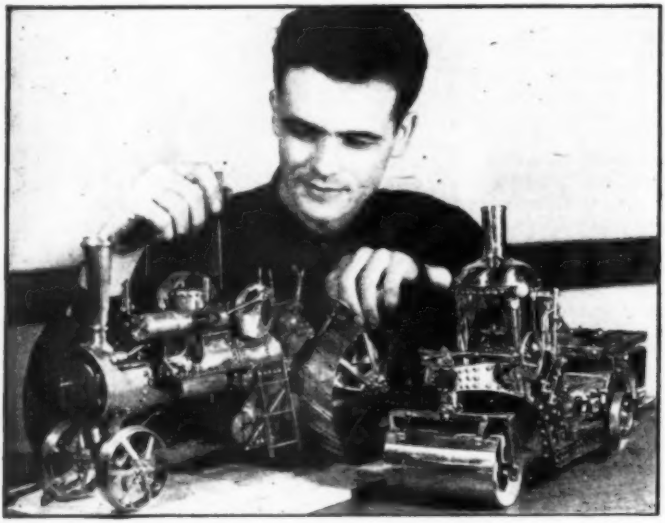
CHIPS *from the* EDITOR'S WORKBENCH

Maynard De Good, of 256 Burt Street, S.W., Grand Rapids, Michigan, receives this month's Workbench $5.00 first award with this photo of his model threshing machine and steam roller. Made on a 6" lathe, they actually run by steam.



Four Million Heroes

CAPTAIN COLIN P. KELLY, America's first hero of the present war, started out life as a model airplane builder and workbench enthusiast. "Scarsdale Jack" Newkirk, hero of the Flying Tigers of Burma, who accounted for 25 Jap planes before his number came up, was a model bug as a youth. Lieut. "Butch" O'Hare, Naval flier who hung up the record for the most enemy planes shot down in one day, was a model bug as a boy, too.

Most of Uncle Sam's fliers of today were yesterday's model makers and workshoppers. It's a fact that begins to take on significance when you learn this additional fact: In 1938, Hitler had 1,000,000 youths building and flying model airplanes! From these youths, he is now getting a minimum of 25,000 pilots a year!

But here's something to scare him: Last year, an estimated 4,000,000 youths were building and flying model airplanes in the U. S.!

All of which leads us to a suggestion made recently by Dr. M. N. Walsh of the famous Mayo Clinic—a suggestion which we heartily endorse. Dr. Walsh wants the schools of America to start giving instruction in aeronautics and model-making to boys and girls in the early grades.

"Such a system will insure that in future times of peace the United States may take its rightful place as leader of the world in the air," Dr. Walsh says.

To which we add—amen!

Contest

WELL, here we are swamped again! Even though our experience last year with Words-Within-Words warned us to expect such a deluge of entries, we were still caught off base again this year as you contestants started pouring in your Words-Within-Words letters. At this writing, we have received over 30,000 entries—and the big rush is yet to come! We're happy to see that the contest is going over with such a smash—but we can't help regretting the fact that the more entries there are, the more disappointed contestants there are bound to be, too. We only wish there were prizes enough to go around to all of you who have worked so hard. However, we're sure those of you who don't win prizes have had a swell time playing the Words-Within-Words game and have learned a lot of new and interesting things about this English language we use.

We're going to try our level best to announce the prizewinners in our next issue (July MI), but we promise you that we're going to be sure to see each individual entry and judge it separately before we make any announcement.

Pictures

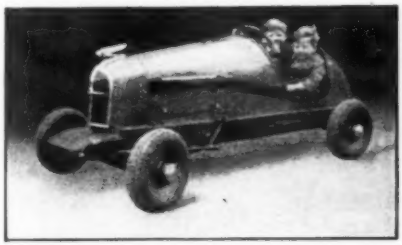
DURING the past few months, the editors of MECHANIX ILLUSTRATED have been obliged to turn down many otherwise excellent workbench contributions because the snapshots submitted were not clear.

Editor's Workbench Chips

The chief trouble seems to be that the article being photographed is placed too close to the camera. This applies especially to snapshots of models, such as model planes, etc. If you use the average type of box camera to take your pictures, or if you use any type of camera that doesn't have "portrait" provisions on it, the chances are that you shouldn't take a picture closer than about 6 feet. You can buy a "portrait" attachment for many cameras, however. Then you can take close-ups. Any way, read the directions that came with the camera so you'll know how close it will take clear pictures. If you take them too close they're too blurred to be used in MI.

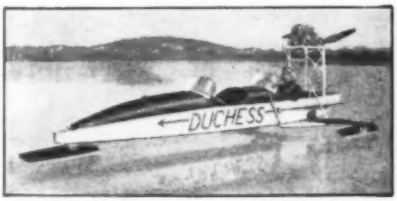
Even if the model seems rather small in a picture taken at the proper distance, we might be able to use the snapshot if it's good and clear.

Another point to keep in mind no matter what type of project you're photographing, is the background. Whenever you can, have the background as plain as possible. For example, if you were taking a snapshot of a dark colored machine—such as a lathe, or motor, you should place a piece



This midget racer was built by Mr. Walter Rahn, of Hobart Street, Gordon, Pa. It's built from old automobile and motorcycle parts, and is powered with a 74 Indian motorcycle engine. The top speed is 50 miles an hour. A $3.00 Workbench award and a Certificate of Merit go to Mr. Rahn for this snapshot.

CAN IT DO 100?



The fast propeller driven ice boat shown above was built by Walter H. Hayden, of 98 Sears Island Drive, Worcester, Mass. It's a 2-passenger job, originally powered with a Henderson motorcycle motor which gave it a speed of about 60 miles an hour. When that engine blew a piston Walt installed an Anzani airplane engine. He hasn't opened her up with the new engine, but his guess is that she could hit better than 100, and he's probably right. The new engine has a 3-blade propeller instead of the 2-blade type shown on the original engine in the photo. It took about 2 months to build this ice boat, and cost about $60, Walt writes. This snapshot brings Mr. Hayden a $3.00 Workbench award and a Certificate of Merit.

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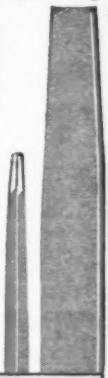

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Editor's Workbench Chips

of plain light colored material behind it. A piece of canvas, an old bed sheet, or some light colored building board will usually do.

It improves the snapshot if you have somebody in the picture along with the project. That makes it possible for readers to estimate the size of the project if it should appear in the Workbench. If the project is a small one, somebody's hand touching it will be enough to show its size in the picture.

Of course, you stand a better chance of getting a good picture if you take it on a bright day. Incidentally, don't hide the project in a confusing array of shadows of trees and bushes. Put the thing to be photographed in an open spot where the sun can shine evenly on it.

Generally speaking, your snapshot results stand a better chance if you rest the camera on something solid—a tripod if you have one, or even a box or table. This is so because slow-speed inexpensive cameras may get a "fuzzy" picture if your hands jiggle a little as you snap it. Before you take the snap you'll have more time to get the project properly centered in the view finder if it's resting on something.

If you have to take the picture of your project indoors you probably know how to do it. If not, you can usually get the advice you need at the store where you buy your flash bulbs or flood bulbs. You can also take a time exposure without using either type of bulb, but if you plan to do that, read the directions that came with your camera. If you've lost them inquire where you bought it.

One final bit of advice—make sure that the article you want to photograph gets in the picture. If you look carefully in the view finder of your camera you'll have no trouble along this line. If your camera is one of the very inexpensive types that has no view finder, all you have to do is "aim it" somewhat like a gun.

We'll be looking for better pictures of some of

John Lecher, of 447 E. Indiana Ave., Philadelphia, Pa., is the builder of this rakish ½-mile racing car. It has a '28 Chevrolet chassis and a Ford engine and running gears. He's already raced it, and he tells us that it handled well and got good results. This photo wins John a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

those projects we hated to turn down. If you submitted a snapshot to the Editor's Workbench and it didn't get in, it may have been the fault of the picture itself. Check up on the old box camera technique and let's see a better snapshot this time. You can all do it—because many Workbench contributors already do. And you don't need expensive equipment to do it.

News for Modelers

MANY of you have written in expressing great interest in the model "Q-Ship" whose plans appeared in the April issue, and not a few more of you have built the model and requested an encore. Such popularity must be deserved, so we've decided to do something about it.

Next month's (July) issue of MI will bring you complete plans and dope for building a model of a U. S. Navy submarine of the "T" class. Naturally, some details which are military secrets have been omitted, but even if we've used our imagination here and there we think you'll agree that it's a beautiful model, and well worth building.

[Continued on next page]

Howard V. Gary, of 1150 Brice Ave., Lima, Ohio, built this trim little motor scooter. Howard's just 16 years of age but he certainly did a good job when he built it. It's powered by a ½ horsepower "souped up" Briggs and Stratton engine which gives it a speed of 35 miles an hour—and 80 miles to the gallon. It does all this with a 150 lb. passenger. Equipment includes a brake and an automatic clutch. This snapshot brings Howard a $3.00 Workbench award and a Certificate of Merit.

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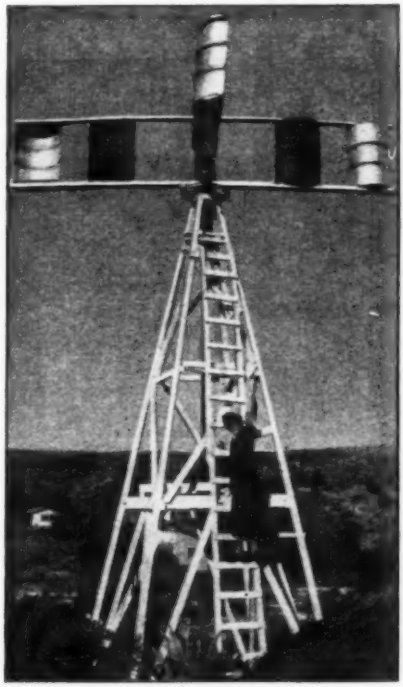
Editor's Workbench Chips

Authors

WE REALLY haven't room enough on the contents page to tell you everything we would like to about MI authors. For instance, Myron Weiss, who wrote "Hitting the Atom Harder" (on page 35) is one of the foremost science writers in America. He was Science News Editor of *Time* magazine for 12 years and has written for many scientific publications . . .

Willy Ley, whose photograph and brief biography appear on the contents page, and whose plea for the manufacture of mine throwers appears on page 56, is one of the world's most versatile science writers. Instead of being an expert in one field—as are so many authors—Mr. Ley is a jack-of-all-science. Besides keeping abreast of developments in the current hurly-burly of munitions science, and writing a daily piece on the subject and finishing up a new book, *Shells and Shelling*, to pair with his *Bombs and Bombing* volume issued last



This windmill was built from MI plans by William J. Burton, of 4218 Burns Avenue, Hollywood, California. According to Mr. Burton, "She's slow but steady, and takes so little wind to move that you can spin it by blowing a puff of cigarette tobacco smoke at it." That certainly is high praise for a windmill, and this one is built from old car parts and a pair of old metal barrels. This snapshot brings Mr. Burton a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

autumn, Mr. Ley pursues a long-standing interest in living evidences of the known and guessed past of this planet. In fact, his book on the subject, *Days of Creation*, was published last winter. Friends tell him they think he delves into the early days of the Earth as a change from the grim reality of war life on it today! Maybe that's an idea for Workshoppers—take up a history hobby as leisure-time escape from today's headlines.

You air-minded readers of MI will be interested to know that Mr. Ley is one of the world's foremost experts on rocket flying, too. His first book, published in 1926 when he was 19, was *Trip*

Charles Irish, of 200 Kensington S., Hamilton, Ont., has been building boats from MI plans for quite a time. He's also built an airplane from FLYING MANUAL plans. He tells us that he and his friend, W. Tremblay spend a lot of time in these boats they've built. The one in the photo is their version of *Scram*, from MI plans. This little speedster has had 6 different engines, and is shown racing along with '36 Chevrolet motor. A $3.00 Workbench award and a Certificate of Merit go to Mr. Irish for this snapshot.

This graceful sailboat is the work of Robert Michenfelder, of 48 South Long Beach Ave., Freeport, Long Island, N. Y. Robert scaled up the original plans of *Nomad*, an MI boat. He tells us that she's one of the handiest and safest boats in the neighborhood. It looks like a beautiful job, and brings Mr. Michenfelder a $3.00 Workbench award and a Certificate of Merit.

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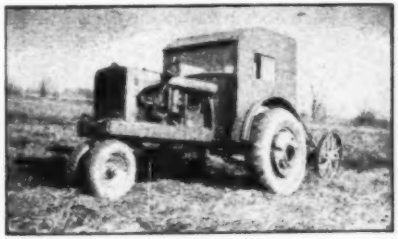
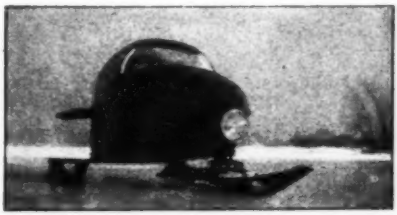
Editor's Workbench Chips

Into Space, and rocket ships for years were his chief preoccupation. His 1928 treatise on the possibility of space travel is said to have inspired the novel from which the sensational German movie "By Rocket to the Moon" was made. Besides writing on rocket ships, Mr. Ley built up a group of enthusiasts who eventually numbered 1,000 owning a rocket-proving ground near Berlin and a full-time staff of six engineers and mechanics. Ley, who speaks and writes English, German, French, Italian, Latin, Dutch, and Russian, corresponded with rocket experimenters in Europe and America and his organization became the world center for news and information on rocketry.

Like so many others of intelligence and education, Ley found Hitler's Germany intolerable and emigrated to the United States in 1935. One of his first acts here was to travel down to Jones Beach to pay his respects to the horseshoe crab, familiar to every visitor to northeastern Atlantic beaches. To him the crustacean was a rare speci-



Steve Karafit, of R. 6, Box 49, Celina, O., built this cab for his tractor. Quarter-inch waterproof plywood is used in it with fir 1 x 2's for framework. The windshield is from a Model A Ford, and the side window from glass obtained in a wrecking yard. The total cost of the cab was $15. This snapshot brings Mr. Karafit a $3.00 Workbench award and a Certificate of Merit.



Bernard Morey, of Brewerton, N. Y., built this 5-passenger motor sled. It's powered with a Model A motor, and has a propeller of Mr. Morey's own design. Construction is almost entirely of wood, the framework being covered with a good grade of unbleached muslin shrunk in place with airplane dope. Mr. Morey says the sled will carry 2 passengers over any kind of snow or ice. When 5 ride in it 3 sit in front. He's never dared to hold it wide open for more than about half a minute, he says. On the ice, it appears, the little high speed streamliner has an urge to hit 200, and Mr. Morey isn't anxious to see how far it could go in that direction. This photo brings him a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

men previously glimpsed only in well-stocked European museums!

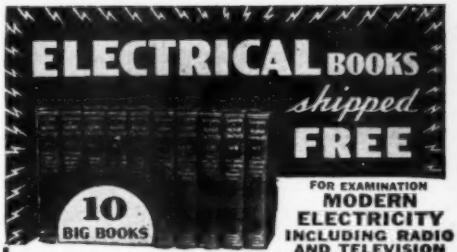
Today he constitutes the science department of New York's adless tabloid newspaper, *PM*, and will become a citizen this year. He is very proud of his new bride, Olga Ley, who is a well-known artist and photographer and famous in her own right as the "exercise girl" of *PM* and the magazine *Parade*.

[*Continued on next page*]

Emmett Sharp, of Woodlawn, Va., R. 1, Box 171, is the builder of this miniature Dutch Windmill. It's made largely of scrap material, Mr. Sharp tells us, as that's his hobby—making something out of almost nothing. This is certainly an excellent job, judging by the snapshot. It brings Mr. Sharp a $3.00 Workbench award and a Certificate of Merit.

THE BOODLE BUG

Roy O. Wells, of 322 West Whitney St., Sheridan, Wyoming, built this "sawed-off" fishing and hunting car. He calls it the "Boodle Bug." It's a 1928 Chevrolet one-ton truck, shortened 48½ inches. The cab is also cut down and rebuilt. It has old 8-ply tires with 4-ply reliners, and carries only about 15 pounds pressure in them. He tells us that it's the best mountain car he's ever tried out, and it'll go places other cars couldn't even start to go. It certainly looks as if it could. Roy says his handy and powerful little private jeep was easy to make, requiring little welding and no machine work at all. This snapshot brings him a $3.00 Workbench award and a Certificate of Merit.



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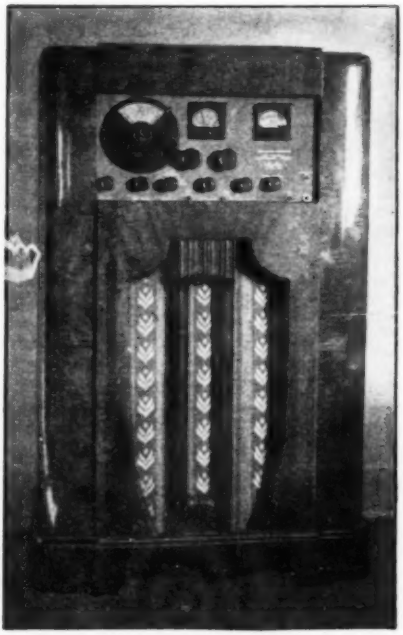
Editor's Workbench Chips

Underbrush

THE WPB (War Production Board) has ordered razor blade manufacturers to curtail drastically their output of double and single edged blades in order to conserve steel for war industries. It is estimated that nearly 1,600 tons annually of high grade steel will thus be diverted from "non-essential" to essential use. Unfortunately, the operation of shaving has come to be an "essential" to most men, Rex Stout and Monty Woolley excepted, and not a few blue chins are going to be hard hit by the announced quota of one blade per week per man. Unless the age of facial fungus is to return, something has to be done about it. And cheer up, you bristling, beetle-browed he-men, something *can* be done about it.

Believe it or not, to use a well-worn expression, the life of the average paper-thin, double edged beard bolo can be at least tripled by a very simple method. All you have to do is go to the five and ten cent store and buy a 2 ounce shot glass—the



This good-looking "living room radio" is the work of Giles Mottle (W9GQZ), of 28325 Hoover Road, Centerline, Mich. As Mr. Mottl is a radio hobbyist he had been keeping the exposed operating unit of his radio on a desk. It looked out of place in the living room so he scouted around for an old console cabinet. When he found this one he simply cut a rectangular hole in the front at the top, and placed the set in it on wooden skids. With a little polishing up, he got this beautiful result. It's not a bad idea for mounting old radios in new cabinets, now that radios may become a trifle scarce. A $3.00 Workbench award and a Certificate of Merit go to Mr. Mottl for this snapshot.

Editor's Workbench Chips

heavy kind with the sloping interior. Take it home and put it in the bathroom cabinet, next to your shaving equipment. When the razor begins to feel like a two gang plow dragging through a field of Buffalo grass all you have to do is place the blade vertically in the shot glass and twirl it rapidly around the sides with the forefinger. First one way, then the other. This will hone it up very nicely and give you a comfortable shave. Do it before each using and it'll easily last a week.

Notes

MAJOR MALCOLM WHEELER-NICHOLSON, MI's war expert, scores again this month. You will remember his criticism of the Army's M-3 tanks which appeared in the April MI. If you will turn to page 90 you will see how the Army has met his criticism: The position of the main gun has been changed as the Major suggested, the silhouette has been lowered, and every other detail of his criticism has been answered . . . Along the same line, we note that the Army has accepted the offer of Elmo Bannister, Texas stunt flier, to train parachute troops in the tech-

Robert Reith, of R. R. 1, Marion, Indiana, built this trim little moth class boat from MECHANIX ILLUSTRATED plans, and tells us that it maneuvers like a runabout. Built mostly of plywood, the little craft was a simple one to plank. That and her speed provide several good reasons for her popularity. Readers who'd like to have a boat like this are probably dreaming right now about the plans of the one that ran in the May issue of MI. Blueprints are available for the new model at $2.00, from Fawcett Publications, Inc., Greenwich, Conn. If you order a set specify blueprint No. 983. This photo brings a $3.00 Workbench award and a Certificate of Merit to Mr. Reith.

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Editor's Workbench Chips

nique of "bat-man" 'chute jumping—another suggestion made by Major Wheeler-Nicholson (in the August, 1941, issue) . . . The South Bend Lathe Works has just issued a new edition of its book, *How To Run a Lathe,* and it is a good one for all lathe operators to have. Copies of it are available for 25 cents. Write the South Bend Lathe Works, Department 9M, South Bend, Ind. . . . A hunch for you car owners: If rust has formed on your automobile's rims, it is a very serious menace to your inner tubes. Inspect the center of your steel rims, clean and treat them with rust-resistant paint . . . Who says America isn't the greatest nation in the world? Our soldiers are now eating off silver-plated dishes! Their knives, forks and spoons are silver-plated, too! The quartermaster corps is using silver to replace chromium, which is much more precious now for the war effort . . . And, to show you how the war has upset our values: Gold is now being used to line chemical retorts and kettles. It replaces stainless steel . . .

Wig Wag

SINCE the article "Flag Initials for Your Car" appeared in the April issue our mail bag has been jammed with letters from sharp-eyed and technically minded readers calling our attention to the fact that some of the flags given in the chart on page 101 in that issue are no longer in use, having been discontinued a few years ago.

To these keen correspondents, and to all our other readers less well-versed in nautical lore, we offer our sincere regrets for the error, and

85 H.P. SCRAM

"I am enclosing some snapshots of *Scram,* which we built from MI plans. And you can bet we are mighty proud of her too. Especially when bystanders say, 'Oh! what a beauty of a boat.' But that isn't the half of it, they get their biggest surprise when they see it performing. Boy, it's a honey!"

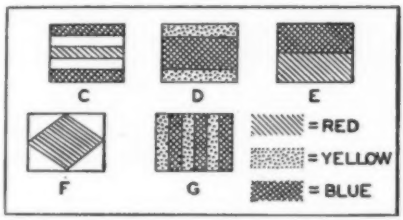
That's the way Marion A. Waller and J. S. Hopkins, of 2013 Jones Street, St. Joseph, Missouri, begin their letter. They used a Ford V-8 85 horsepower motor in the boat with the flywheel forward. A marine reversing transmission and universal joints complete the job to the propeller shaft and to a log shaft of their own design. A Cadillac water pump cools the engine, the water being exhausted through jacketed exhaust pipes to the rear, cooling them en route.

They end their letter with a post script saying that they'd be glad to answer questions from readers to the best of their ability. The picture brings Marion and J. S. a $3.00 Workbench award and a Certificate of Merit.

Editor's Workbench Chips

wish to report that the faces of those responsible are a satisfactory shade of crimson. We have no alibis either—it was just one of those things.

Readers who are not familiar with the International Code of Signals situation may be interested to know that the letters C, D, E, F and G (plus some other changes which do not concern us here) were altered in 1934, after an international conference in which the various maritime nations participated. Rough spots were ironed out, and all the pennant shaped flags were made to represent numerals, while the rectangular flags stood for letters of the alphabet. Thus the confusion caused by having a few alphabet flags also represent numerals was avoided, and the whole system better standardized. Below we give you the corrected flags for the third to seventh letters of the alphabet:



George J. Deschler, Jr., of Route 1, Box 239-A, Racine, Wis., is the builder of this trailer. Incidentally that's George sitting beside it. It cost $130, and includes a built-in cupboard and electric lights. The sides and ends are built from ⅜" plywood, making the trailer quite light. It can be towed 50 miles per hour behind a car without difficulty, Mr. Deschler tells us. This snapshot brings George a $3.00 Workbench award and a Certificate of Merit.

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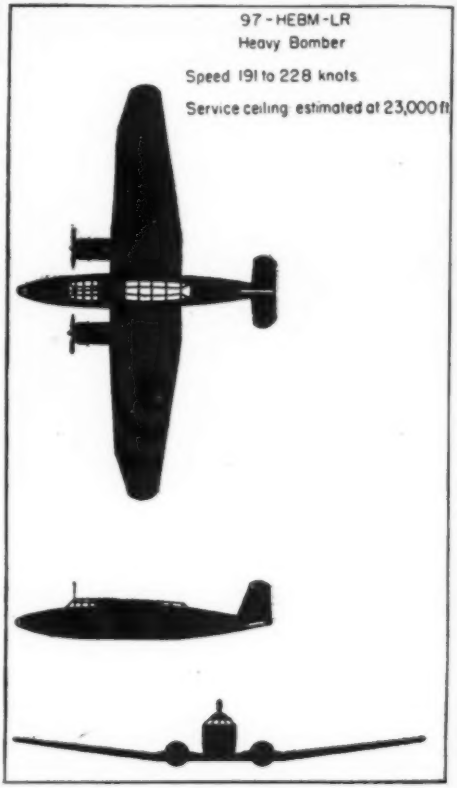
Jap Bomber's Small Tail Makes It Touchy Flier



This Jap bomber carries a maximum bomb load of 3,000 pounds. Four 30 caliber machine guns are also carried, but are of little effect against even quarter inch armor. U. S. planes are now being designed for considerably heavier armor than this, however, as many Axis machines being used on the European front carry 50 caliber machine guns as well as aerial cannon. Although this particular ship is of somewhat cleaner lines than many of the Japanese machines in present use, it still carries an amazingly small tail. While this feature reduces drag and weight somewhat, it also is likely to make the ship a touchy flier. Likewise, a more pronounced adjustment of stabilizer would be necessary to compensate for any shift in C/G following a release of part of the bomb load. The rudder area, however, is large in proportion to the horizontal tail, doubtless improving spin characteristics.

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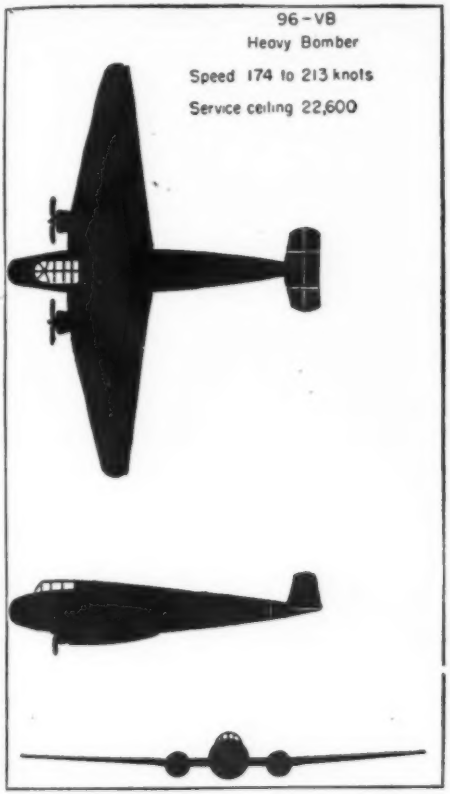

This Mitsubishi 6-place bomber is an interesting mid-wing design. A maximum bomb load of 2,230 pounds can be carried by this ship, which has a circular fuselage cross-section in common with most modern ships of its type. It also includes the peculiar rudder arrangement common to most Jap machines at the early stages of the war. The surface area of the horizontal tail is almost equally divided between stabilizer and elevator, a feature that may have been picked up from the German Heinkel. The service ceiling of these ships is more than 10,000 feet below that of the American Flying Fortress, although the Mitsubishi carries only a fraction of the load in proportion to its power. It is sometimes used as a torpedo carrier, in which case it carries a single torpedo.

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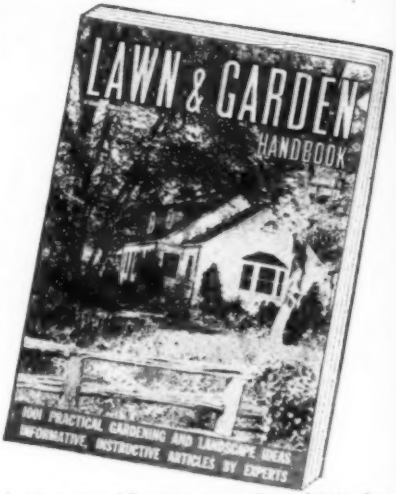

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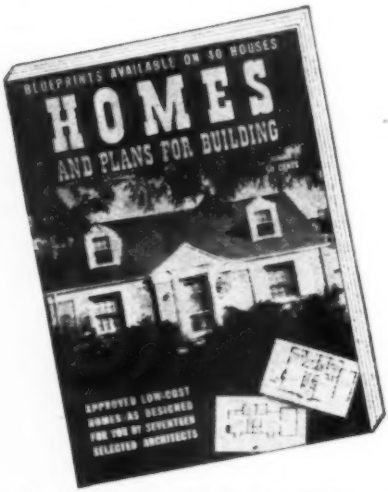
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ABSOLUTELY FREE—Scott's Latest De Luxe Loose-Leaf $3.50 Album, covering entire Western Hemisphere—or—Standard $3.00 Stamp Catalogue, to approval applicants becoming customers. Our approvals feature only the finest and latest South and Central America. "America's Stamp Service", Palm Springs, California.

VICTORY PACKET Free—Includes stamps from Tanganyika—Borneo—Animal—Scarce Babyhead—Coronation—Early Victorian—Airmail—Map Stamps—with Big Catalogue—all free—send 5c for postage. Gray Stamp Company, Dept. MM, Toronto, Canada.

FREE! LEEWARD Is., Carman Is., Turks & Caicos plus 60 different mint Geo. VI Coronation poster stamps, to approval service applicants sending 3c postage. Tatham Stampco., Springfield-D9, Massachusetts.

APPROVALS' give you the opportunity to examine various assortments of stamps before buying. This is a special Courtesy Service extended by Stamp Dealers. Cooperate with them by looking over Approval Stamps as soon as you receive them. Then send payment for the stamps you keep; and return those you don't want.

BUY AMERICAN! U. S. only. 500 mixed—25c! 100 different better commemoratives $1.00; 50 different 35c. No approvals. Price list on request. Dan Watson, Dept. MI, Box 825, Columbus, Georgia.

UNITED STATES. Hard to get, yet inexpensive stamps in our approval books. 1500 varieties in stock. Southern Stamp Co., Box 70-X, Miami, Florida.

GET THE best stamps through our Stamp Exchange Club.e Write for particulars. Globe Cover Service, 707 25 Street, Oakland, California.

Springy Plastic Hoops Make New Chair

Constructed entirely without metal, this new war-time chair takes its design inspiration from the flowing lines of modern airplanes, according to the architect who planned it, Lewis M. Scott. It's considered so ingenious he was awarded a patent for the design. Weighing only 20 pounds and needing only two yards of upholstery material, the chair is supported on two springy hoops of the same transparent plastic from which bomber noses, turrets, and inclosures are made. The model in which Miss Ruby Stevens is shown seated above combines amber Plexiglas with blue velvet.

FREE COMPLETE Set Jugoslavia semi-postals to applicants for selected sets on approval. Herold, Box 1127B, Woodhaven, New York.

80 SELECT U. S. Commemoratives, 48c; 500 Mixed U. S. Stamps over 150 Varities, 58c. Jungkind, Box 806MX, Little Rock, Arkansas.

U. S. #648, 5c Hawaiian, Catalog Value 60c, only 20c to applicants for U. S. approvals. M. Haycock, 61 Obrien Place, Brooklyn, New York.

ASTONISHING! 100 DIFFERENT 5c! Attractive approvals. United Stamp Service, Box 491-T, Lexington, Kentucky.

PICTORIAL COLONIALS! Two colorful mint sets, 3c. Approval applicants only. Porter, Box 181e, Duncan, Oklahoma.

60 DIFFERENT U. S., including Commemoratives, Airmail 10c. No Approvals. Seidenberg, Baroda, Michigan.

RUSSIA'S NEW defense set (4). Enclose postage, approvals. Ressler, Third Street, Somerville, New Jersey.

MANCHUKUO THREE Complete Sets 5c. Meyers, 485 West Third, Peru, Indiana.

FREE PREMIUM with approvals. Large Stamps, 1123 Cleveland, Racine, Wisconsin.

INDIAN CURIOS, RELICS, ANTIQUE FIREARMS

ANTIQUE FIREARMS, Indian Relics, Swords, Minerals, Antiques, Circular. Museum, Wenona, Illinois.

25 GENUINE INDIAN Arrowheads, $1.00. Catalog. Geo. Holder, Glenwood, Arkansas.

RARE COINS

HIGHEST CASH Prices Paid for Indian Cents, Lincoln Cents, Old Rare Coins. Know Coin Values, It Pays. Send 10c for 1942 Catalogue of prices paid for all U. S. Coins. American Rare Coin Co., Dept. 2, Transportation Bldg., Chicago.

FREE! FOREIGN Coin, banknote and large 50 page illustrated coin catalogue to approval service applicants. Send 3c postage. Tatham Coinco., Springfield-9, Massachusetts.

COMMEMORATIVE 3½s. Columbian, Lincoln, Stone-Mountain, Long-Island, Cleveland, $1.00 each. Large illustrated Catalogue 25c. N. Shultz, Salt Lake, Utah.

Plastic Glazing Strip Replaces Putty

This thick, flat ribbon of pliable plastic covered with lead on the outside takes the place of putty and other glazers on windows. Once pressed into shape with the putty knife to fit any given contour, it retains that shape indefinitely, or until reshaped to another contour. It adheres closely to wood and glass with a water- and air-proof seal, is indestructible, non-oxidizing, and insecticidal. It comes in rolls handy for applying and is shaped and cut to length on the job.

HOBBIES, COLLECTIONS

BEAUTIFUL STONES removed from rings, etc. 100 assorted $2.00. Lowe's, Box 311, St. Louis, Missouri.

TWENTY DIFFERENT cactus plants postpaid $1. Art Glovers, San Dimas, California.

MAGIC TRICKS, JOKERS, PUZZLES

MYSTIFY FRIENDS! Make tricks fascinating hobby! Become a magician. Earn good money. Dollar trick, two catalogs, circulars, all for dime. Nelmar, J-2851 Milwaukee, Chicago.

WE SUPPLY every noted magician. Large Professional catalog 25c. Holden, 222 West 42nd St., New York.

SIXTEEN WORLD'S best card tricks and catalog 25c. Sterling Magic, 345 John R., Detroit, Michigan.

NASTY HITLER Trick Sheet 10c. Baker, Box 164-M, New Castle, Indiana.

CHALK TALKS

TRICK CHALK Stunts, Catalog 10c. Cartoonist John Balda, Oshkosh, Wisconsin.

DETECTIVES

DETECTIVES—SECRET Investigations—Easy Method by Former Government Detective. Finger-prints, Secret Code, Booklet, Free. Write—International Detective Training, 577-M Orpheum Building, Jersey City, New Jersey.

DETECTIVES—WORK Home—Travel. Experience unnecessary. Detective Particulars free. Write, George Wagner, 2640-V Broadway, New York.

HYPNOTISM

HYPNOTISM, COMPLETE 20 Method Course 25c. Western Institute Hypnotism, D-1313, Palatine, Illinois.

MUSIC—INSTRUMENTS & INSTRUCTION

NEW POPULAR text book, scientific piano tuning and servicing, $3.00. Howe, 116 Pinehurst Ave., New York.

HAWAIIAN GUITAR Music. List on Request. Golden Gate Publications, 1724 Telegraph, Oakland, California.

LEARN SWING piano! Postal brings free folder. Christensen, 768 Kimball Hall, Chicago.

SONGWRITERS

"SELL YOUR Songs" New Booklet, 25c—music set to words $1.00. Commonwealth Conservatory, 423 7th Street, Boston, Massachusetts.

SONGWRITERS, write for free booklet, Profit Sharing Plan. Allied Music, Dept. 45, 7608 Reading, Cincinnati, Ohio.

SONGWRITERS! AMAZING, convincing offer. Hibbeler, C32, 2157 No. Avers, Chicago.

BODY-BUILDING COURSES

EXERCISE EQUIPMENT, courses. Special offers! Free booklet. Good Barbell Co., 4676AX So. Grand, St. Louis, Missouri.

CAMERA & PHOTO SUPPLIES

FOR VERY little money, you can build an ultra modern Photo Enlarger that handles any size film from 33 mm. to 9x12 cm. Any hobbyist with average skill can make it. Complete instructions, diagrams and plans—only 25c. (Limited supply on hand.) Specify Booklet 3. "How-To-Build-It" Editor, Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Connecticut.

SAVE MONEY on films, rolls, packs, etc. W.B.L., 724—49th Street, Brooklyn, New York.

PHOTO FINISHING

36 EXPOSURES DEVELOPED and printed to 3¼x4½ $1.00. 18 exposures developed and printed to 3¼x4½ 75c. 8 exposures developed and 8 doublesize prints 25c. Split rolls developed and printed doublesize 35c. Write for Complete Price List. Village Film Laboratories, Dept. A, Box 4046, Village Station, Los Angeles, California.

THE PHOTO Mill. Immediate Service! No Delay! Eight exposure roll developed, printed and your choice of two beautiful 5x7 double weight professional enlargements, one tinted enlargement, or eight reprints for 25c coin. Developing and eight Jumbo prints 25c coin. The Photo Mill, Box 629-K, Minneapolis, Minnesota.

FOR THE Discriminating Amateur—8 exposure rolls, 2 prints each, 25c. Miniature rolls enlarged 2 to 6 times, 8 exposures 25c. 16 exposures 50c. 35mm. 36 exposures, 3x4 enlargements $1.00. Unexcelled quality, prompt service. Paramount Photo, 1583—1st Avenue, New York.

ROLLS DEVELOPED and 4x6 oversize glossy Velox prints 8 exposure 30c. 12 exposure 45c. 16 exposure 60c. Overnight service. Clemet Photo Service, 1318 W. Columbia Ave., Philadelphia, Pennsylvania.

EVERY PICTURE an enlargement! 8 sparkling deckle-edge Enlargements and roll developed 25c coin; 116 size or smaller; enlarge reprints 3c. Enlarge Photo, Box 791C, Boston, Massachusetts.

KODAK ROLL developed with 16 guaranteed deckle-edge Velox prints 25c; 36 exposure 35MM roll DK20 developed vaporated enlarged to 3x4 $1.00. Superlabs, Box 68, Elroy, Wisconsin.

QUALITY DEVELOPING—Prompt Service. 6-8 Exposure Rolls two each, 25c. Free Enlargement Coupon. Postcard brings mailer. Petyt Studios, 3310W 65 Street, Chicago.

AMAZINGLY BEAUTIFUL hand colored prints 6-8 exposure roll developed, printed 25c trial. Reprints 4c each. National Photo Art, D116, Janesville, Wisconsin.

SIXTEEN BEAUTIFUL Hollytone prints with eight exposure roll developed—25c. Hollytints, M-1350, Hollywood, California.

ROLLS DEVELOPED Two Sets Prints 23c. Reprints 20c. Dozen 35MM. Enlarged 75c. 120-08E Liberty, Richmond Hill, New York.

ROLL DEVELOPED with sixteen guaranteed fadeless glossy prints for quarter. Modern Photo, Box 30, Plaquemine, Louisiana.

SPECIAL—BEAUTIFUL 8x10 rich sepia enlargements only 50c. Silverstein, Dept.-M, 180 W. Washington, Chicago.

MOTION PICTURES & SOUND EQUIPMENT

8-16-35MM FILMS. Bought, Sold, Exchanged. Complete Subjects $2 up. Catalogue, sample film 10c. International, 2120 Strauss, Brooklyn, New York.

DEVELOP YOUR own movies. Save 60%. Bulk films—Prepared developers. Write Genera Company, Davenport, Iowa.

ESO-S 8MM movie films 50% less. Spooled or bulk. Ask for D-10 Catalogue. ESO-S, 3945 Central, Kansas City, Missouri.

Infra-Red Heat for Fast Darkroom Drying

Designed for studio and darkroom use where speed in drying is essential, this new heat lamp generates a flood of infra-red rays that are converted into deeply penetrating heat as soon as they strike film or paper. The drying process is started from the inside out. The ruby color is pigmented into the glass while still molten; the ruby glass permits the worker to turn from the relative darkness of safelight illumination to the faint ruby illumination of the new bulb without eyestrain or shock to optic nerves. Among the uses of the new lamp are the speeding up of the drying of ferrotyped prints, prints drying on blotters or on stretched-cloth drying frames, and the quick drying of single films or strips of roll film. In cold months when low-temperature solutions are a problem, the new bulb provides rapid heating of processing solutions, and quick drying of roll film tank reels, tanks, accessories, wet towels, etc. Made only in 250-watt size, the bulb has a burning life of 6,000 hours.

DRAMA & WESTERN 35MM Silent Film. Linden Film, 501 Adams Street, Steubenville, Ohio.

8-16MM FILMS. All types. Free catalogue (sample 10c). Garden Film, 317 West 50th, New York.

USED 16mm. sound film—100 feet $1.00, postpaid. Blackhawk Film, Davenport, Iowa.

HOME MOVIES

$1 BRINGS "SURPRISE" assortment 8MM Tinted Titles! LeMoine Films, Nevada, Missouri.

MOVIES, 1942 CATALOG Free; Samples 10c. Goodwill Company, Jackson, Tennessee.

AUTOMOBILES—MIDGET CARS

WHIRLGAS SUPERCHARGERS. $3. Increase mileage 20%; power 10%. Refund guarantee. University test. Any car; give make, year. Wrench installs 15 minutes. John Hanley, Manufacturer, 5719 Loraine, Detroit, Michigan.

MIDGETS, MOTORSCOOTERS, parts, motors. Used and new. Complete lists (50 motors, $5.00 up), 20c. Shipps Midgets, Box 543-B, Zanesville, Ohio.

RECONDITION MOTOR without installing new rings! No priorities! Devereaux, Box 212-B, Battle Creek, Michigan.

AUTO SUPPLIES & EQUIPMENT

CONVERT YOUR car to burn Diesel oil. Save up to 70% fuel costs. Cheap installation. Wonderful performance. Proven factory method. Different and better. Costs nothing to investigate. Write for free circular No. 5A. Harrington Company, 201-204 Manchester Building, Portland, Oregon.

RETREAD TIRES with old casings, new method, blow torch main tool required, free literature, or send $1.00 for complete instructions, simple, cheap, no priorities, satisfaction or money refunded. The Harris Co., Boaz, Wisconsin.

TIRES BAD? Repair your own. Inexpensive, no equipment, instructions 50c. Irving, B367, Haverhill, Massachusetts.

Desk Leaf Provides Table Space, Too

A boon to offices and apartments of limited space is this new desk with drop-leaf which can be raised when additional area is needed to spread out work of the person typing. In an apartment, the leaf would permit converting the desk into a table large enough for meals for two persons; some of the drawer space could hold linen and silver, the rest, stenographic materials.

AUTO TRAILERS

ALL ABOUT trailers, construction, parts, supplies, etc. 64 pages vital information for anyone interested in home trailers. Send 25c. Stephes Co., 2801MI 14th, Kansas City, Missouri.

MOTORCYCLES, BICYCLES, MOTOR SCOOTERS

MOTORCYCLES, RECONDITIONED. New, used, parts and accessories. All makes. Large stock. Bargains. Illustrated catalog, 15c. Indian Motorcycle Sales, Kansas City, Missouri.

MOTORSCOOTER, MIDGET car parts, kits. Closing out! Stamp brings circulars. List 50 used motors ($5.00 up). 25c. Shipps Midgets, Box 543-B, Zanesville, Ohio.

MACHINERY, TOOLS & SUPPLIES

RECLAIM DULL and broken drills, with Nu-Way Drill Grinder Circular Free. Tractor-Lite Mfg. Co., Sidney, Iowa.

GRIND DRILLS like factory: attachment for bench grinder. Cheap. Factory, 811-C East 31, Kansas City, Missouri.

ELECTRICITY & ELECTRICAL SUPPLIES

ELECTRIC PENCIL: Writes—Engraves all Metals. $1.00 postpaid. Beyer Mfg., 4515-G Cottage Grove, Chicago.

WELDING—PLATING—SOLDERING

BUILD D.C. Arc-welder. Plans, Supplies. Welders Club, BB-3432 M-Mart, Chicago.

FOR INVENTORS

INVENTORS:—HAVE you a useful, non-military invention for sale? Practical new ideas, patented or unpatented, urgently needed by manufacturers and consumers. Write for details. Chartered Institute of American Inventors, Dept. 5-B, Washington, D. C.

PATENTS: LOW cost. Book and advice free. L. F. Randolph, Dept. 341D, Washington, D. C.

GET YOUR own patents. Blanks, instructions $1. Cudding Sons, Campbell, California.

CASH FOR practical ideas and inventions. Mr. Ball, FA-9441 Pleasant, Chicago.

PATENTS

INVENTORS:—FORESIGHTED manufacturers already planning post-war sale of new non-military products. If you have a useful invention, patented or unpatented, write Chartered Institute of American Inventors, Dept. 5-A, Washington, D. C.

INVENTIONS PROMOTED. Patented or Unpatented. Write Adam Fisher Co., 582 Enright, St. Louis, Missouri.

PATENT ATTORNEYS

INVENTORS—PROTECT your idea with a Patent. Secure "Patent Guide"—Free. No charge for preliminary information. Write Clarence A. O'Brien and Harvey Jacobson, Registered Patent Attorneys, 23B-F, Adams Building, Washington, D. C.

"INVENTOR'S GUIDEBOOK" containing 96 mechanical movements and advice about patenting, selling inventions, also "Record of Invention", Free. Frank A. Ledermann, Registered Patent Attorney, 151 Nassau Street, New York.

PATENTS. BOOKLET free. Highest references. Best results. Reasonable fees. Watson E. Coleman, Victor Building, Washington, D. C.

INVENTIONS WANTED

INVENTORS:—SMALL manufacturers need new inventions for altered civilian markets. If you have a practical, useful idea for sale, write Chartered Institute of American Inventors, Dept. 5-C, Washington, D. C.

INVENTORS: UNPATENTED inventions now salable with positive safeguards under patent laws. New, low-cost procedure. Complete details, free. American Patents Corporation, Dept. 11, Washington, D. C.

INVENTIONS PROMOTED. Patented or Unpatented. Write Adam Fisher Co., 582 Enright, St. Louis, Missouri.

CASH FOR Inventions—patented or unpatented. Mr. Ball, FB-9441 Pleasant, Chicago, Illinois.

MANUFACTURER WANTS new invention or idea. Nelson, Dakota Bldg., St. Paul, Minnesota.

MODEL & MODEL SUPPLIES

MODEL PUSHER Plane that's far superior to conventional gas models. Pusher protects propeller and motor from damage on rough landings. Terrific climbing ability. You don't have to be an expert to make it. For complete instructions, plans and diagrams, send 25c to "How-To-Build-It" Editor, Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Connecticut. Specify Booklet 1.

JUST OUT! New model speedboat kit, 27"x8". Class "C". P-T torpedo type hull. All parts prefabricated. Mahogany trimmed thruout. Patented shafttube block, shaft. Full size plans, photographs, instructions. Price $6.50 postpaid. Circulars 5c. Bermoco, Berwyn, Maryland.

STEAM ENGINES boilers. Circular 10c. Anton Bohaboy, 2297 Price, Rahway, New Jersey.

SHIP MODELS

SHIPS! NEW catalog; Kits, fittings, accessories. 128 illustrated pages 25c (contains refund coupon). Polks, 429-D Seventh Avenue, New York City.

MODEL RAILROAD SUPPLIES

RAILWAY MODELS. Complete Line Informative Catalogs G gauge 112 Pages 25c. HO 48 Pages 15c. Walthers, 235 Erie, Milwaukee, Wisconsin.

MODEL ENGINES

LATEST ENGINE Catalog 25c. Refunded. Howardes., M-2417 North Ashland, Chicago.

HOME CRAFTSMEN

CATALOG: PATTERNS Plywood Novelties, Lawn Ornaments, Silhouettes, Letters & Numerals. Decal Transfers, Handy Hand Tools, New Power Sander. Other Lines. 500 articles finely illustrated. Write today. Wo-Met Shop, Ashburn, Georgia.

MAKE $17.00 FOR 14 hours of spare time work. Assemble and sell Dillabaugh Rowboats. I furnish material, parts, instructions. Write today for big money making proposition. C. R. Dillabaugh, 7911 Mallory, Portland, Oregon.

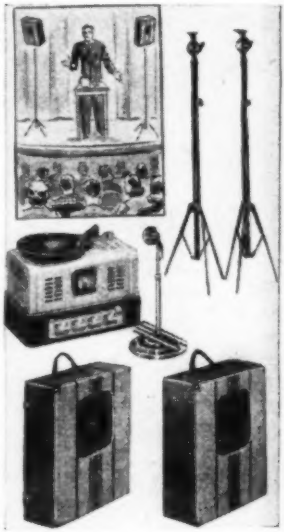
WOODCRAFTSMEN—THREE 8x14, three 6x9 whatnot patterns all for 25c stamps or coin. Catalog free. Carter Brothers, Ferrum, Virginia.

PRECUT HOBBY Lumber Selected Northern Hardwoods. Send for Folder—M. Andorra Forest Products Co., Marlow, New Hampshire.

1000 TELUHOW PLANS. Homeworkers of all ages. New illustrated catalog 10c. C. King, East Kingston, New Hampshire.

REFINISH FURNITURE. Instructions 10c. Write P. Kepko, 500 Thornton St., Sharon, Pennsylvania.

New P. A. System Set Up Quickly



New aid in solving problems connected with public address situations is provided by this system which can be set up in a few minutes. It uses only 30 watts of electricity for operation. Two speaker cases mount on two ingenious fold-down speaker tripod stands, which can be extended from 46 to 78 inches and have adjustable swivels. The system also includes an amplifier with phono top and tubes, a low-feedback microphone, a takedown stand, and a portable case, in addition to cables, etc.

BUILD-IT-YOURSELF

BUILD YOUR tractor from second-hand automobiles! Convert your horse drawn farm equipment into tractor drawn equipment. Nolan's Garage, East Wareham, Massachusetts.

MAKE RATTERY charger, fly spray, plastic wood. Instructions 10c. Benson Corners, Litchville, North Dakota.

BOATS, OUTBOARD MOTORS

ENJOY ALL the thrills of fishing and sailing in your own beautiful 18-ft. Cabin Auxiliary Sloop. Easy to build if you follow instructions. Complete plans, diagrams and instructions, only 25c. Specify Booklet 1. Write today to How-To-Build-It Editor, Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Connecticut.

U-MAK-IT BOATS—Easy-to-Build, Kayaks, Rowboats, Dinghies, Outboards, Inboards, Sailboats. Runabout for auto engines. Over 300 in stock. Complete kits. Simple to assemble. Send 10c (coin) for all catalogs with illustrated construction details. Largest selection offered. Kayak Boat Co., 152A-East 129th St., New York City.

OUTBOARD MOTORS—used and rebuilt bargains, list free. Used parts, save money. Crandall-Hicks Co., 953 Commonwealth, Boston, Massachusetts.

KAYAKS, OUTBOARDS, Rowboats, Duckboats, Construction Kits, '42 Models, 10c for Catalogs. Cre-Craft Boats, Millburn, New Jersey.

SAILKITS 100 SQUARE foot area $6.75, other sizes. Sails for all boats. Alansail, 95 Chambers, New York City.

FORD AND Zephyr marine conversions. 10c coin. Lehman Engineering Company, Dept. C, Newark, New Jersey.

OUTBOARD MOTORS, used parts. Outboard Exchange, 9614 Flatlands Ave., Brooklyn, New York.

SPORTING GOODS, FISHING TACKLE, GUNS

WE BUY for Cash, Trade, Sell Used Guns, Ammunition, Binoculars, Stoeger Arms Corp., 507 Fifth Ave., New York.

SEND 10c FOR list 100 used guns. Frayseth's, Willmar, Minnesota.

DOGS & DOG FOODS

DALMATIAN—WHITE Collie—Rat Terrier Pups. Sheckler Kennels, Nevada, Ohio.

ARCHERY

BOWS—ARROWS: Construction-Instruction Book 50c. Catalog free. Archery, 617 South State, Chicago.

ARCHERY EQUIPMENT. Catalog free. Eagle Arrow Co., 3115 East Monument, Baltimore.

FIELDGLASSES, TELESCOPES, MICROSCOPES, ETC.

LENSES—BUILD your own telescope, field glass, microscope, riflescope, etc. Assortment of fifteen lenses—$1.00 postpaid. Slightly chipped on edge. Satisfaction absolutely guaranteed. American Lens Company, 324 North Mayfield, Chicago.

SPECTROSCOPES

SPECTROSCOPE for quick chemical analysis $2.50. Cudding Sons, Campbell, California.

REAL ESTATE, FARM LANDS

40 ACRES NEAR White River, unimproved poultry land. $190; $5 down, $5 monthly. Free list and literature. Hubbard, 224 Grossman Bldg., Kansas City, Kansas.

AUTHOR'S SERVICE

NEW WRITERS wanted to re-write ideas in papers, magazines, books. Splendid opportunity to "break into" profitable writing field. Rush postcard for Free Details. Comfort Writer's Service, Dept. F-140, St. Louis, Missouri.

PERSONAL

MONOGRAM YOUR own cigarettes—simple, quick, distinctive. Electrogenizer will do many thousand. Send 50c in Defense Stamps for complete unit—also your initials and specify type—Script or Modern. Electrogenizer Co., 3223 Olive, Chicago.

WIN PRIZE Money: Booklet—"Successful Contesting" Shows how. 10c postpaid. Bulletin listing $100,000.00 prizes included. World Publishing, 4515-K Cottage Grove, Chicago.

LOWEST PRICES blades, Aprils, X-cellos, Silvertex, Texide; many others. Free details. Star Products, Dept.—A, Buffalo, New York.

CONQUER ILLEGAL Slot Machines! Particulars, 3c stamp. Devereaux, Box 212-F, Battle Creek, Michigan.

MEXICAN LEGAL Matters. Wm. Cocke, Reliable American Attorney, El Paso, Texas.

MONUMENTS

MONUMENTS—DIRECT Low Prices. Freight Paid. Lettered. Guaranteed. Free Catalog and samples. Write Granite-Marble Factory, A47, Oneco, Florida.

BOOKS, PERIODICALS, PICTURES, POSTCARDS

MASSIVE BARGAIN divisiocatalogs rarest Oriental success secrets. Unobtainable elsewhere. Psychology, Hypnotism, Occultism, Magic. $1.00 (Deductible). Nothing Free. Transcience, Box 37, Chicago.

ANY BOOK (New, Used, Out-of-Print, Rare) promptly supplied! Lowest Prices! Send for Free Bargain Catalogues! Old Prof's Book Shop, 116 Arcadia Court, Pontiac, Michigan.

ARTISTIC PHOTOGRAPHS. List, sample, dime. Parisette, 55 Nunn Building, Rochester, New York.

WATCHES, WATCHMAKING, ETC.

WATCHMAKERS' MATERIALS. Tools, Jewelry—bought, sold. Best prices for Old Gold, Diamonds. Free Catalog. Ben Segal Company, Box 150, Chicago.

ELGIN, WALTHAM Watches $3.50. Make big money. Free watch and jewelry catalog. Plymouth Jewelry Co., 163-C Canal St., New York.

WATCHES $1.98 UP. Elgin, Waltham, Bulova, etc. List free. Wineholt, Box 857, Woodbine, Pennsylvania.

MINERALS—PRECIOUS STONES

SEND 10c FOR Beautiful Gem Tourmaline crystal with Catalog request. Rare gems, fossils, minerals, gem cutting equipment, fluorescent lamps. Grieger, 405 Ninita Parkway, Pasadena, California.

START A Gem or Mineral Collection. 6 rough Gemstones, genuine, $1.00 postpaid. Catalog with complete listings Free. Hill Co., B7-R, Salem, Oregon.

JEWELRY

GENUINE DIAMONDS, out-of-pawn prices, unredeemed loans and distress merchandise; men's, ladies' rings, one carat $95.00, ¼ carat $15.00. Shipped for Free Inspection. Appraisal. Send for Free List, hundreds of beautiful diamonds, very low prices. Lloyd Butler, President, Prudential Loan Association, 133-GF North Clark St., Chicago.

MISCELLANEOUS

REAL FRIED Chicken Recipe. Tender, Juicy, Wonderful Flavor, 25c Coin Or Stamps. Garland, Box 236, N. Tonawanda, New York.

RECEIVE GIGANTIC mails, magazines, samples. Your name in numerous mailing lists 10c. Howard, 396 Broadway, New York.

75 DOUBLE EDGE razor blades postpaid for dollar bill. Howard Co., P.O. Box 336, Libertyville, Illinois.

BURIED TREASURE, Minerals, free booklet, photographs. Fisher Laboratory, Palo Alto, California.

MORE BUYERS for your money. Write to Bill Corvell, 23rd Floor, 1501 Broadway, New York City.

WELDING GENERATOR. Remsen, 82 Route 29, Hillside, N. J. Wanted: Sea Diving Equipment.

WANTED—MISCELLANEOUS

CASH! GOLD, jewelry, teeth, coins, diamonds, mercury, etc. Ship! Simon's, 353 Old Arcade, Cleveland, Ohio.

Letters To The Editor

To the Editor:

That "new" ack-ack gun shown on page 91 of your March issue can't possibly be anything but an "old" Lewis gun dug out of some World War I armory. It was patented somewhere around 1911 and was used by the British army in Flanders in 1914.

Did someone slip up or did someone slip one over on you?

Paul St. Gaudens
Coconut Grove, Florida

A slap on the wrist to the news editor.

* * *

To the Editor:

On page 91 of the April issue of MI you state that the Republic "Thunderbolt" is the fastest fighter plane in the world.

Now, I don't say that it is not the fastest, but the British have had a plane out for several months called the Hawker Typhoon which has a single Napier Sabre engine of 2,350 h.p., and it looks so smooth and streamlined that compared to the Thunderblot it seems as though it should be 50 to 75 miles an hour faster.

Guy Ness
Big Spring, Nebraska

While we can't tell just how fast the Thunderbolt is, we can tell you that no plane in the world can pass it—no matter how streamlined the other plane may look.

* * *

To the Editor:

I've read almost every book and magazine on sailboats, sailing, navigation, etc., ever published. Your BOATING HANDBOOK was no exception. It's by far the best all around publication. Many amateur sailors like myself have always wanted to see a MECHANIX ILLUSTRATED type of magazine dealing only with yachting.

Especially enjoyed were "Improving the Breed" which summed up in simple language Dr. Curry's theories on aerodynamics; "Learning the ABC of Sailing," which, in a few pages, does what many beginners books have failed to do; and "Elements of Navigation," for its understandable presentation.

The articles on sailmaking, sail planning, sail rigs, fittings, buoys and care of sails are excellent. Unlike most articles of this sort, which, from time to time have found their way into non-boating magazines, they appear to be written by men who know boats.

I never wrote a letter of this sort before. If too many Long Island sailors aren't in the Navy, you should receive many more.

Pvt. Louis Cohen
Co. B, 16th Engrs.
1st Armored Division
Fort Knox, Kentucky

* * *

To the Editor:

Thanks for the article on book shelves in your February issue. Some of the larger stores in Pittsburgh featured similar shelves at substantial prices in their advertisements of the same period. We were able to make these shelves of very satisfactory quality with the aid of your plans, and the cost was only about 25% of that asked in the advertisements.

Harry T. Bowman
Aliquippa, Pennsylvania

* * *

To the Editor:

Your February 1941 issue had plans for a novel mousetrap cigarette lighter. My hobby is making gadgets like that and I was wondering if any of your readers might have some plans for something like the cigarette lighter who would be willing to sell them for a small sum.

Peter J. Myers
109 Westmount Ave.
Toronto, Ontario, Canada

[*Continued on page* 33]

SAVE UP TO 50% ON A NEW BOAT!

HERE'S THE BOOK THAT TELLS YOU HOW

YES, you can cut the cost of a new boat anywhere from twenty-five to fifty per cent! How?

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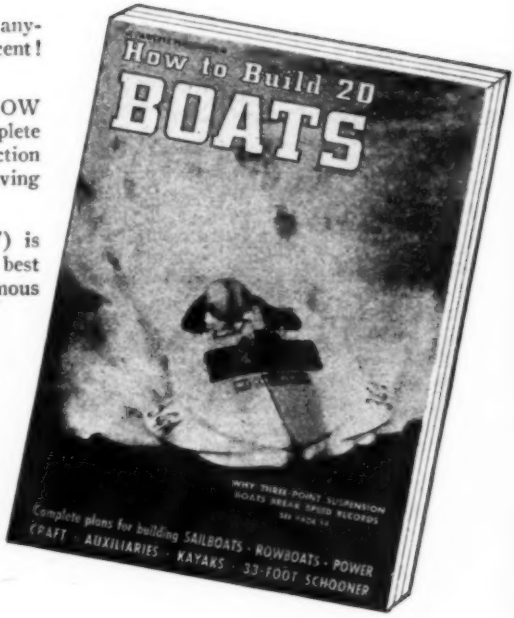

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(CANADIAN ORDERS NOT ACCEPTED)

Letters To The Editor

[*Continued from page* 31]

To the Editor:

I have gotten every issue of MECHANIX ILLUSTRATED for the last two and one half years and the contests you run at different times are very enjoyable. So far I haven't won anything, but I am out trying harder than ever.

I was especially pleased with the drill press in the January issue. I would like to have more articles like these, such as a jig saw and a circular saw, and other such power tools.

Gerald Schuster
Dubuque, Iowa

* * *

To the Editor:

In the March issue there is shown a method for electroplating baby shoes. I would like to know approximately how long the article must be left in the solution with the current on, as I want to try this out.

In my estimation, every time I spend a dime for MI, I get a dollar's worth.

Edward L. Klotz
3707 North Kenneth Avenue
Chicago, Illinois

The length of time the shoes should be left in the solution depends upon the strength of the current being used. About two or three hours is a good average.

* * *

To the Editor:

I read MI every time there is a new issue off the press. I have copies dating back from January 1940 and not one has an article on skating, which is my hobby. Couldn't something be done about this in future issues?

I would like to correspond with anyone interested in skating, mainly roller skating. I save stickers, ticket stubs, pictures of skaters with whom I am corresponding and anything connected with the sport, and have a good collection of these things from many rinks on the east coast.

Bob Gray
High Flyers Roller Club
Health Center Skating Club
Norfolk, Virginia

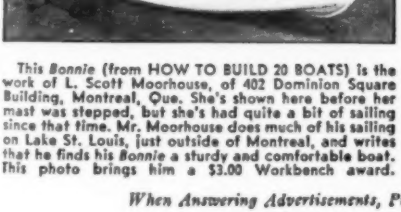
* * *

To the Editor:

In the April and May issues of MI is an article on the propellerless plane. I had an interview with Sir Hiram Maxim at Bexley Park, London, England, the second Tuesday in May, 1894, on that same subject, having traveled from Manchester for his opinion.

About 1909 in Nevada I patented an airplane arrangement to open slots *across* the wings to eliminate nose dives, to pancake a machine and slow down for landing. About 1915 I designed and made a shock absorber that allowed the axle to move up and down as the present types do, but I didn't patent it as it looked too simple. That was my mistake.

John Harvey
955 Golden Gate Ave.
San Francisco, Calif.



This *Bonnie* (from HOW TO BUILD 20 BOATS) is the work of L. Scott Moorhouse, of 402 Dominion Square Building, Montreal, Que. She's shown here before her mast was stepped, but she's had quite a bit of sailing since that time. Mr. Moorhouse does much of his sailing on Lake St. Louis, just outside of Montreal, and writes that he finds his *Bonnie* a sturdy and comfortable boat. This photo brings him a $3.00 Workbench award.

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Hitting The Atom Harder

ST. PAUL
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The huge, fantastic-appearing machine above is the world's largest X-ray, in the U. S. Bureau of Standards at Washington, D. C. But the tiny doughnut below will produce rays even mightier than the great machine above. It is a betatron.

The betatron is man's newest weapon for cracking the mystery of this ultimate particle of matter.

by Myron Weiss

MAN is about the only animal that can throw things. The monkey can throw coconuts, but only wildly, with no direction. The skunk can throw a stream of protective fluid a short distance. Man first gained his supremacy over other animals through his ability to use his hands by throwing sticks and stones.

Through his ability to throw things, man learned to extend his power. By devising bows and arrows and slingshots, he learned to throw things harder and farther. Today's bomber is merely an extension of man's ability to throw.

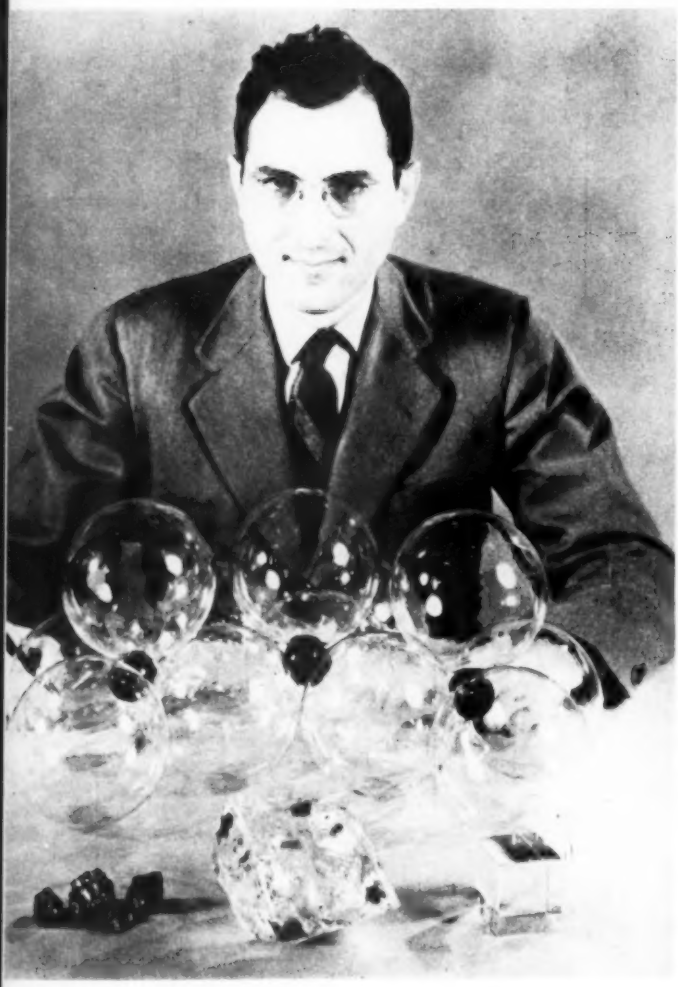
Most of man's throwing—both by hand and by mechanical devices—has been devoted to violence, to killing. But now man is learning to utilize his power of throwing for beneficial purposes.

Strangely enough, the hardest things to throw are the lightest things in the world. The lightest things in the world are protons and electrons—the infinitesimal particles which make up atoms. The world is built of molecules of matter. Everything in the world—your body itself, your chair, your food—is made up of molecules. Molecules are built of atoms. Atoms are built of protons, electrons, and other sub-atomic particles.

In order to pick up these protons and electrons and *throw* them, scientists must use tremendous power—power that runs into millions of volts.

Why should scientists want to throw protons and electrons? The answer is not simple. Principally, it's because they have found that by using protons and electrons to bombard atoms, they can alter the structure of the atoms themselves.

Weird things happen when you alter the structure of an atom. You can, for instance, change ordinary quicksilver into precious gold by bombarding the mercury atom with protons. Scientists have already done this unbelievable thing that alchemists sought for centuries to do. The process costs too much to make it worth while—but they can do it.



Here is a glass model of an atom. A betatron destroys its structure.

By bombarding metals with electrons, scientists can make the metals radioactive. By so doing, they can create artificially X-rays more powerful than radium itself gives off. The powerful X-rays of radium already are doing wonders in the treatment of cancer. Scientists are now asking: May not this greater source of X-rays prove to be a *cure* for cancer?

No one can tell at this time. The science of throwing protons and electrons is so new that we cannot yet tell definitely what it will accomplish.

The science of throwing protons and electrons requires machines entirely new to human experience. Young American scientists who learned to use their hands and minds when they were small town boys tinkering around their home workshops have invented and built the best of such machines. Professor Ernest Orlando Lawrence of the University of California has a 15,000,000-volt

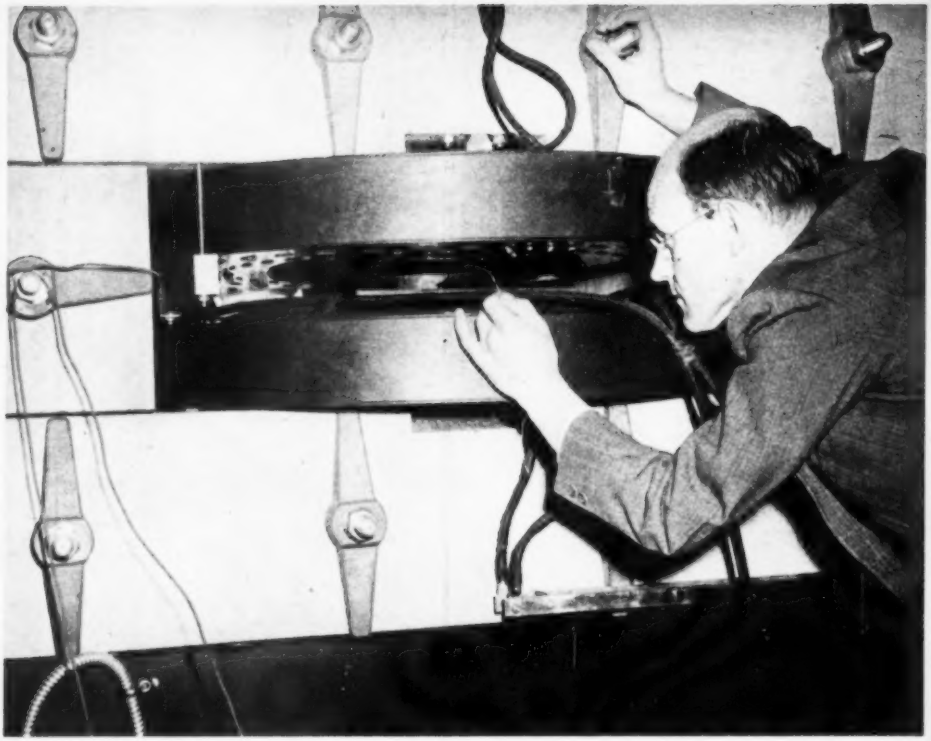
Dr. Donald Kerst, inventor of the betatron, is seen (center) examining one of the fully assembled ray machines.

generator. He calls it a cyclotron. Professor Donald William Kerst, of the University of Illinois, has a 20,000,000-volt machine which he calls a betatron. Before another year passes each will have boosted the voltage he can generate to 100,000,000 volts. They will really get to work at smashing atoms.

As scientists now picture the atom, it has a core—or nucleus. This nucleus is a tight little entity made up of electrically-positive bundles of energy called protons, together with electrically-negative bundles of energy called electrons. Protons weigh 1,800 times as much as electrons. Around the nucleus of an atom another set of electrons is supposed to swirl. These are called orbital electrons. They vary in number and arrangement according to the kind of atom to which they belong.

The force with which these fractional parts of the atom cling together is vast. And to break them apart systematically has become the modern physicist's ambition. To accomplish this he must use forces at least as tremendous as those cementing the atom together.

Professor Lawrence uses the 15,000,000 volts that he has at his command to fire free



Here is the place where the "Doughnut" seen on page 35 fits. This betatron is in General Electric lab.

protons at atomic targets. He applies this force little by little yet swiftly to the free protons, by whirling them around and around in his cyclotron somewhat like a boy whirling a buckeye at the end of a string. MECHANIX ILLUSTRATED in February reported Professor Lawrence's latest accomplishments and the progress of his new $1,400,000, 4,000-ton, 100,000,000-volt cyclotron.

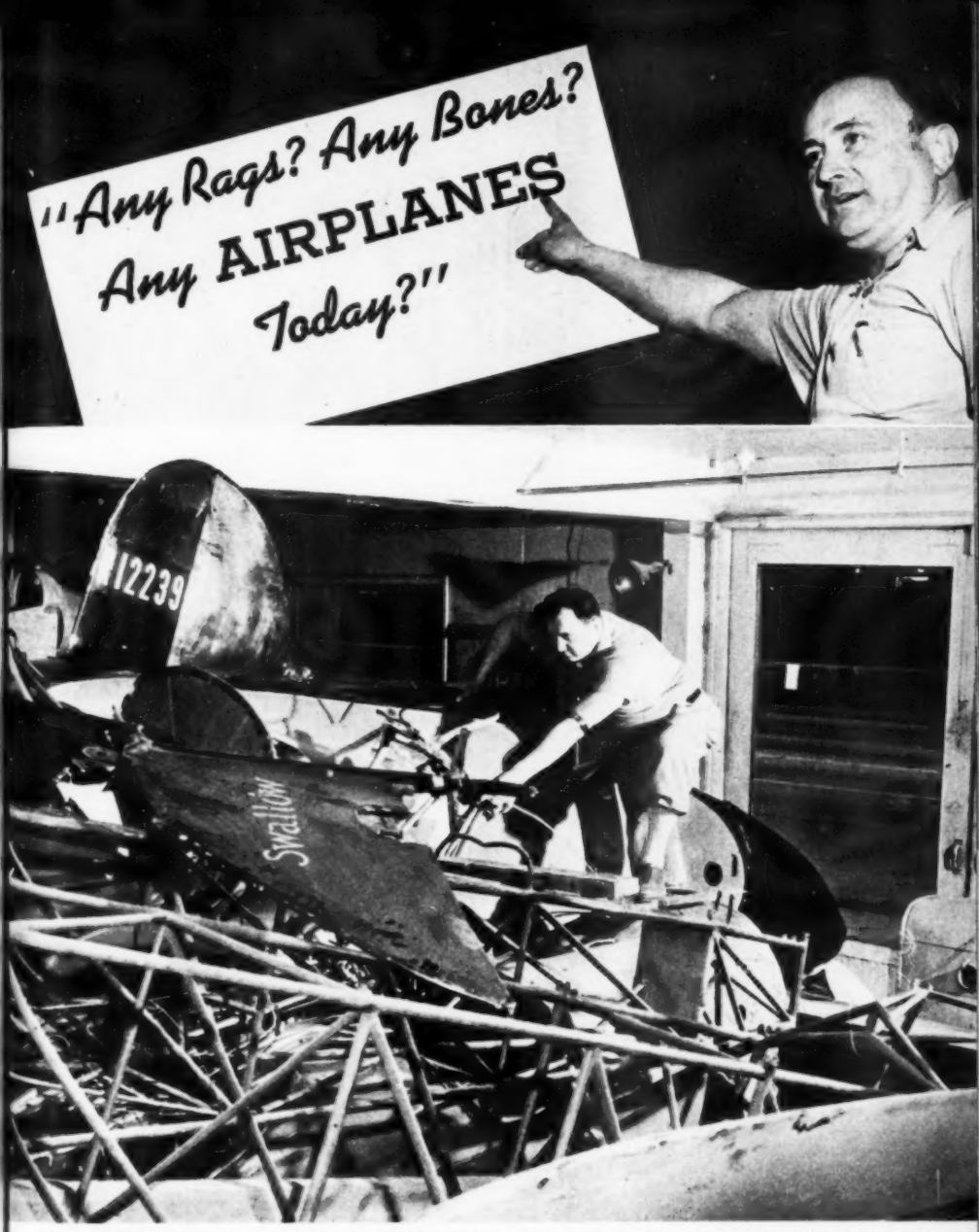
Professor Kerst, who celebrated his thirtieth birthday only last November, produces free electrons and throws them at great speeds with his betatron. He built his first machine only two years ago. The first one generated 2,300,000 volts. His second one, which General Electric helped him complete at their research laboratory in Schenectady only a few months ago, produces 20,000,000 volts. This second machine he has just taken to his University of Illinois laboratory to try it out on the whole gamut of the 92 elements. Meanwhile General Electric is putting a quarter of a million dollars into a third electron generator. It will be completed this summer and is confidently expected to produce 100,000,000 volts.

The clever part of Professor Kerst's device is a hollow glass doughnut. The bigger one which he is now using measures 19 inches in outer diameter, 11 inches in inner diameter, and two inches in thickness. The hollow is kept at high vacuum. Inside is a metal filament which can be heated to emit free electrons. Also inside is a tungsten target against which Professor Kerst can direct the electron stream. The doughnut rests within the field of a powerful, four-ton electro-magnet.

In action the magnet acts like the primary of a common electrical transformer. It actually gives a push to the wireless "secondary current" of electrons freely flowing around the inside of the doughnut. This secondary current of course comes from the heated filament within the tube. Each time these electrons stream around the tube the magnet gives them a 70-volt boost. Within a few seconds they are encircling the tube some 400,000 times a second and attaining a speed

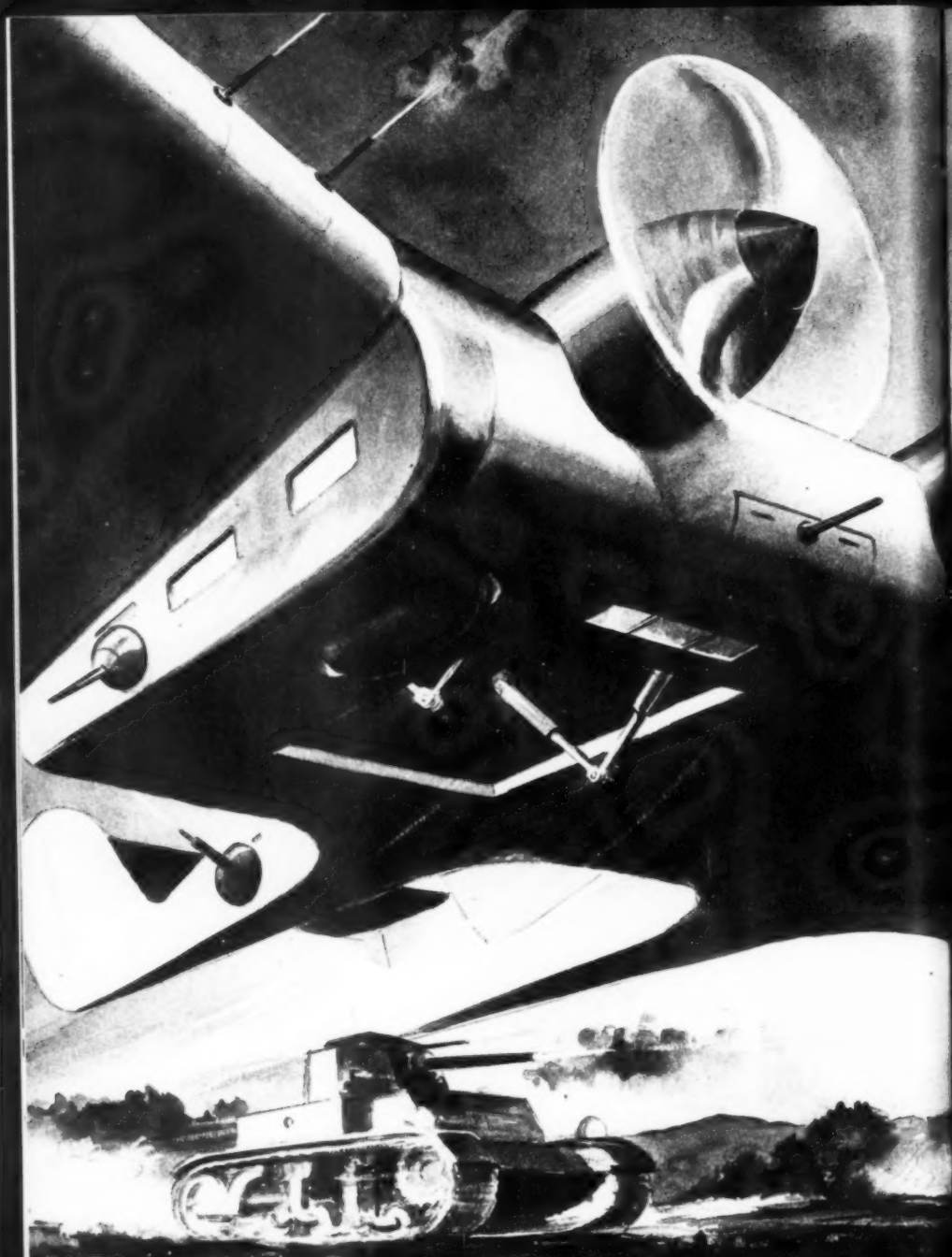
[*Continued on page* 155]

"Any Rags? Any Bones? Any AIRPLANES Today?"



Arrigo Balboni shrewdly estimates the resale value of a newly-acquired wrecked airplane in his specialized junk shop.

WHEN Arrigo Balboni crashed his plane near Los Angeles a few years ago, he fortunately escaped serious injury although his plane was a wreck beyond possibility of repair. Today he looks back on that dangerous accident as one of the luckiest events in his life—not because of his escape so much as the fact it crashed him into a unique business which has been paying him an excellent income. He runs the country's only junk yard specializing in airplanes! This career started when . [*Continued on page* 169]



Burnelli Did It First

Mechanix Illustrated Drawings by Reynold C. Anderson

A HUGE transport plane snarls down on a battlefield. Panels in the great ship's belly open. Two tanks slide out of the belly, like retractable landing gears. The treads on the tanks start rolling—rolling up to a speed of 70 miles per hour. The great plane settles lower and uses the two tanks as a landing gear to touch the ground. As the tanks touch ground, a mechanism clicks and releases them from the plane. The tanks roar across the battlefield at 70 miles per hour, guns spitting. With a howl of acceleration, the great plane zooms upward again—to wing back to its base for more tanks.

A dream? A Jules Verne nightmare? Not at all. Such a plane is actually on a designing board at the present time!

And the airplane designer evolving this fantastic plane is, of course, Vincent Burnelli from America's Lone Star State of Texas.

We say "of course" because Vincent

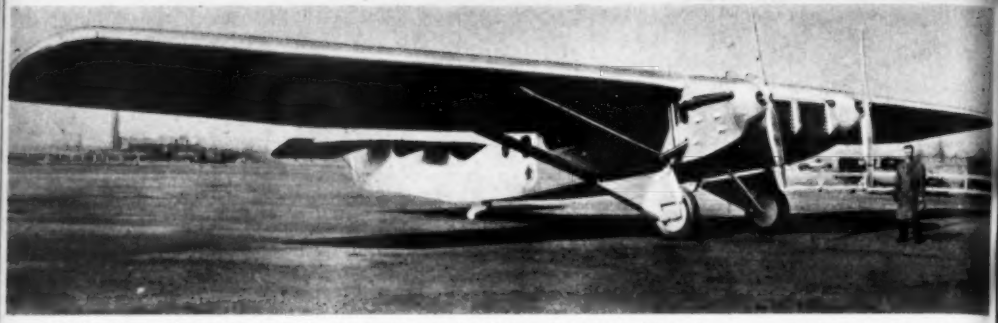
Artist's version of Burnelli flying tank carriers of the near future. When idea was made public in 1922, fliers scoffed.

A wizard of aviation actually designed, built, and flew the planes of tomorrow 20 years ago—and they hold the lead today!

George Daniels

Mechanix Illustrated

Aviation Editor



Another Burnelli first. This 1927 ship, the CB-16, was the first multi-engined airliner to use a retractable landing gear.

Burnelli is probably the only man in the world who has been visioning such a plane. For the name "Burnelli," although not widely known to the U. S. public, is synonymous with advanced all wing type airplane design, just as the name of Edison is synonymous with electric light. Over a period of nearly 30 years, Burnelli has been developing transport planes of far reaching possibilities and he has been consistently first in new developments.

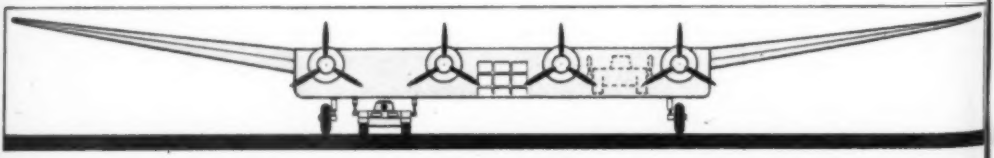
Actually, he has been working on tank-carrying planes since as far back as 1922. While we cannot tell you the details of his tank-carrying planes, other than from a patent drawing and our artist's conception of them, we can tell you about Burnelli, himself, and his impressive designs of the past.

Vincent J. Burnelli. His flying wings make aviation history.

Designing an automobile showroom isn't an unusual feat when it's done in the ordinary way. The one that Vincent Burnelli designed was something different, however. It could fly. It actually did fly very nicely with the automobile right in it, along with all the salesmen, the furniture, desks, and incidental displays of various kinds of automotive accessories. But that's old stuff. Burnelli did that in 1925 when the Model T was still rolling off production lines. The flying showroom didn't carry a flivver though, it carried a full fledged Essex coach on its flight from city to city.

That was by no means the first achievement of designer and builder Burnelli. Unlike many figures in aviation, he wasn't born with a blazing, bombastic determination to make things fly. "I just happened to fit into it. . . ." he says. It all started when he was just a kid who'd learned engineering. He landed a job as draftsman in a Long Island coffin factory—converted to building Moisant airplanes. The name Moisant has more punch to it when you remember that John B. Moisant was the first man to fly around the Statue of Liberty in an airplane, and then land where he started—Belmont Park. N. Y. He won $10,000 doing it.

But Moisant's brother Alfred B., who operated the factory, had to lose his young draftsman because the young draftsman was destined to become the design and construction head of a half dozen aircraft companies in as many years. Without knowing it, he held the course of history in his hands when the great Lawson Airliner—his construction job—took off with an epoch-making load of important Washingtonians. Among the passengers was Senator Harding—later President, and 16 other U. S. Senators. Afterwards, the imposing list of politicos who rode in that ship provided the deciding votes that kept America out of the League of Nations. If that plane had crashed—well "Vince" Burnelli, as his friends call him, would have become of notable effect on history. But the ship didn't crash,



Artist's sketch of giant Burnelli tank and troop carrying plane. It taxies over tanks to pick them up. In air, wheels also retract.

Cutaway drawing of giant future troop and weapon carrier as envisioned by artist. This sketch shows only the central and port section and one engine room in ship.

though severe engine trouble developed during the flight over Washington. The Lawson airliner is credited as being the first airliner in the world. It made a tour of large cities of the U. S. starting from Milwaukee, where it was built.

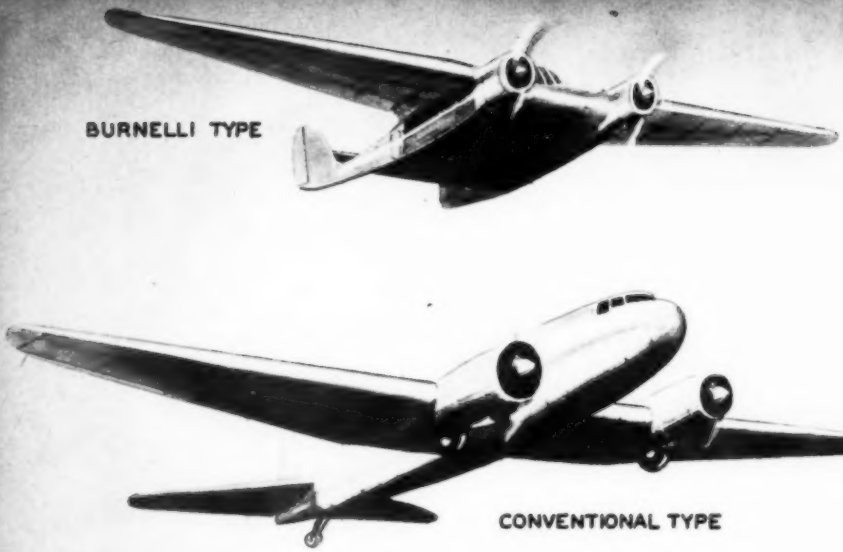
After the event was over, a young reporter made the usual query, "What do you think of the airplane of today?"

Vincent Burnelli knew what he meant when he smiled politely and said, "It's just being born."

He had an idea and he didn't give a tinker's dam for the fact that aviation bigwigs called it impossible. He wanted to develop a fuselage shaped like a wing so that the whole airplane would lift. One more conventional engineering job convinced him. The 30 passenger Remington-Burnelli Airliner was the result. Then, in 1921 the fun began.

Burnelli applied for a patent on the lifting fuselage and started building his fantastic ships. Unbelievable as it seems, the fuselage could lift as much weight into the air as the wings. Even though he had amassed bundles of theoretical proof in advance, when the first big ship actually went aloft and demonstrated the point, Burnelli was almost surprised.

It was in 1922 that he first thought of carrying war tanks in his planes. He had already built his airliners with the engines *inside*—in a forward engine room for easy attention in flight. Obviously, even with such tremendous weight carrying capacity as his ships had, it would be difficult for them to land and discharge the tanks in the type of country likely to be encountered in wartime. And yet the value of high speed delivery of these weapons was inestimable. Vince Burnelli was determined to find the answer, and he did. He designed a plane more startling than a fiction writer's dream. The patent drawings even showed especially made tanks suspended in

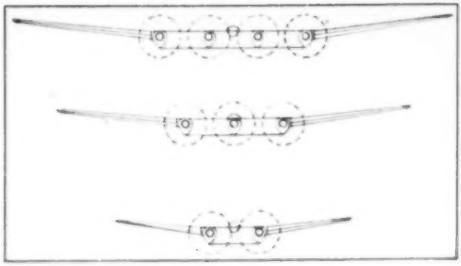


Above: Here's the difference between ordinary planes and those of Burnelli. In latter type, entire fuselage lifts like wing.

the under side of the broad airfoil shaped fuselage. The aperture from which the tank was released would provide an ideal exit for chutists as soon as the ship gained sufficient altitude.

As with all other advanced ideas he was told that it couldn't be done. That didn't bother him because he hadn't planned to do the job right away. "It takes about twenty years to fully develop a good idea," he said. And today in 1942, just twenty years later, he's ready to prove the point. Such great flying war monsters as visioned and now practical may easily add a new concept to modern warfare.

Rough wartime air bases hold no terrors for Vince Burnelli's huge wing-bodied air giants. Eight years ago when one of his experimental ships lost its ailerons at 250 miles an hour, due to a mechanic's assembly error, the plane struck the ground at more than 2 miles a minute. It had been flying only 50 feet off the ground in a speed test, and rather than risk flying without ailerons over the crowded city bordering the airport, the pilot chose to risk death in a deliberate high-speed crash. The ship plowed deep into the frozen ground but the pilot and engineer walked out of it afterwards for a smoke. Uninjured, pilot Lou Reichers pointed out to astonished "rescuers" that the cabin was absolutely intact, windows were whole, windshields hadn't cracked—in



Burnelli plans to increase size of commercial transports and freighter planes merely by adding sections to broad wing-shaped fuselage as shown above. Each section added also adds a motor. The sections increase both lift and power.

fact even the gas tanks were in perfect shape and hadn't leaked a drop.

Clyde Pangborn, world famed long distance pilot, added an almost incredible accomplishment to those already on the list of these strange flat airliners last year. He provided a happy answer to the war fliers' old worrier—what to do when your controls are shot to pieces. The way Pangborn rigged up the Burnelli transport he was flying in war torn Britain, nothing important would happen if the controls *were* shot away. He added an auxiliary elevator panel and flap at the rear of the wing-like fuselage and demonstrated that he could control the ship in every longitudinal attitude, even landing, whether the tail surfaces were working or not!

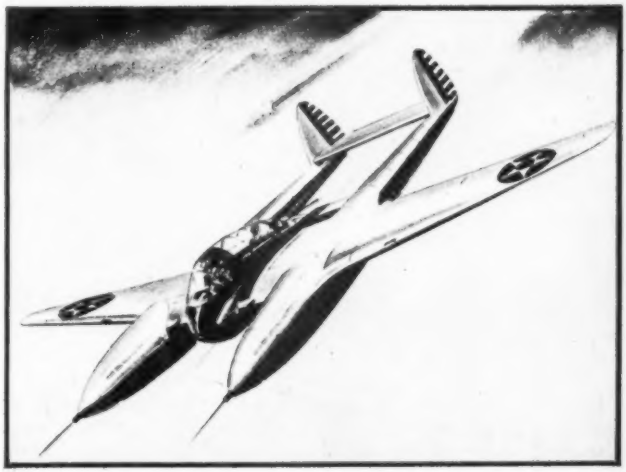
Up to now all these bizarre ships have had only two engines, but a plan has already been

Believe it or not, this is a scene *inside* a Burnelli plane. This one could carry 30 passengers with ease. The car which it carried around the country is shown in place in the cabin. It was driven up a ramp into the ship through one side of the huge fuselage.

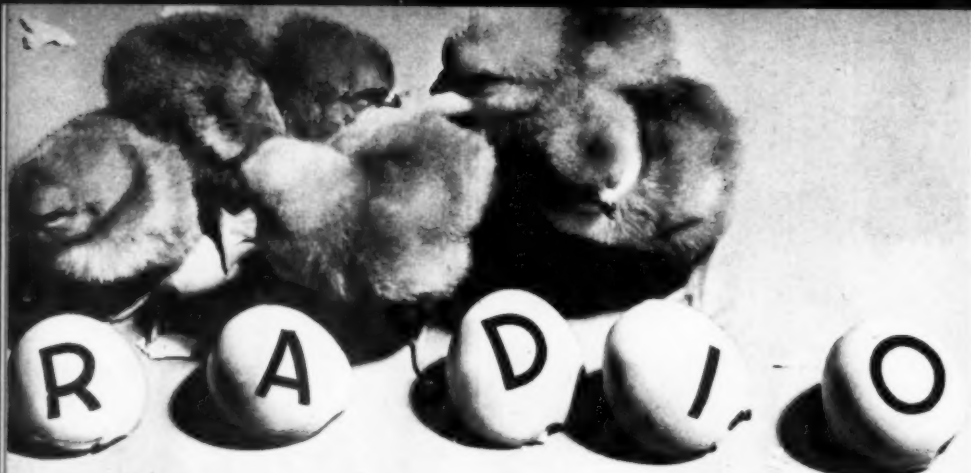
completely worked out to build commercial transport planes of practically any size, simply by adding sections to the wing-like fuselage of sufficient width to install another engine and propeller. All the sections would be alike in shape, and each one would contain an engine. Adding sections would make the body wider and wider, until it would carry almost the entire load of the plane in the air. The wings attached to the sides of the giant airfoil shaped fuselage would become relatively insignificant with increases in fuselage width, and function to provide lateral aileron control and lift at landing speed. Anyway, the wings of the ships are designed so that they can be quickly disengaged from the body if the plane should be forced down at sea. The body of the plane then floats like a substantial life boat. Provision is made to release the wings and for a powerful outboard motor to drive it back to land.

But imposing airliners, air freighters, bombers, and tank carriers are not the only aerial advancements Burnelli has conceived. A total of 53 United States Patents and applications and 37 foreign ones have been issued to him. One of the incidental features tested on an early Burnelli plane created a near panic when the ship prepared to land at a neighboring airport. Spectators watched in horror as a sleek pontoon seaplane

[*Continued on page* 174]



This Burnelli design employs a thick wing section between the engine units and center section for lift and strength.



CHICKS

by
S. R. Winters

Every egg hatches into a chick (above) if radio-testing has been used to select fertile eggs. Size, weight, and shape were factors the scientists (right) figured in.

NOW entwined in the daily routine of nearly all human beings, radio promises to become an important factor also in the delicate relationship between a hen and her chicks.

To its other talents and tasks radio has recently added an ability to tell the hen (or her owner) which of her eggs are fertile and therefore hatchable.

No hen has yet been reported impressed by this fact, but a great many hen owners are. They are delighted to know which eggs—that is, infertile ones—to keep out of their incubators. Time, incubating heat and space, and precious food material are saved. The elimination of this waste would be important at any time, but has taken on greater value with our entrance into war. Part of our program of aid to Great Britain includes the sending of vast quantities of eggs—nine billion dozens a year! Obviously, then, preventing waste is as essential as increasing production in keeping

[*Continued on page* 175]

Need We Fear Chemical War?

An American plane lays down a smokescreen. The enemy may spray poison gas by the same method.

Here are the facts on poison gas and incendiary bombs and how to guard against them.

by Marshall Perham

NO WEAPON of modern warfare strikes more terror in the uninitiated than chemistry—yet when properly understood, probably no weapon is more easily controlled and nullified. Once chemical warfare meant only the use of so-called poison gases; today, it includes the use of incendiary material. In spite of the world-wide terror of poison gas, if proper defense measures and precautions are used, the incendiary chemistry is the more effective of the two.

With the outbreak of war, the army immediately rushed trained specialists in chemical warfare to all parts of the country that might conceivably be attacked to instruct defense groups. These in turn were to form the nucleus of an instruction corps, that facts and methods of handling a chemical blitz might be property of the public at large.

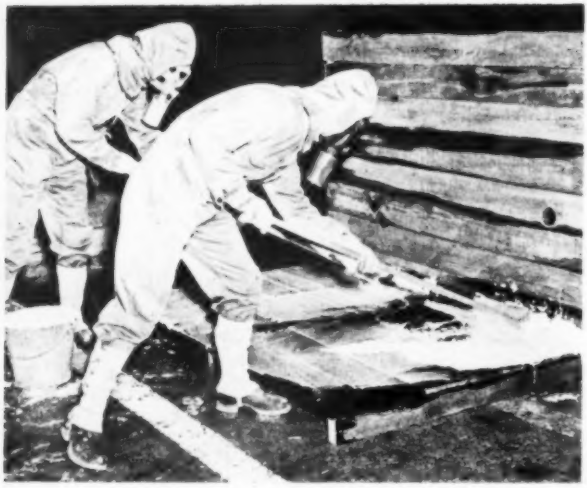
Let's take a look at the various kinds of chemical weapons that might be used against our cities, and see what should be done to combat them.

First, the so-called poison gases. These fall into several classifications. One is the lacrimator, familiarly called tear gas. This is

More terrible, in chemical war, than the worst poisonous gas is the Nazi flame-throwing tank, shown in the photo above.

not a deadly chemical, and is used only to harass persons against whom it might be used. Effects are but temporary, and it is highly unlikely that a surprise attack on any of our population centers would be made by it.

Another classification is called the sternutator. This includes all of the irritant smokes, arsenic compounds, which incapacitate for extended periods by causing violent vomiting, and extreme pains in the head and chest. However, these symptoms wear off in time, with no appreciable ill effects. There is one word of caution in regard to these chemicals, however; any food or drink left exposed to them should be thrown away, since the arsenic will poison them, and render them unfit to eat.



Mustard gas contaminates everything it touches. Left, scrubbing away the gas.

The most deadly type of military gas is the toxic agent, of which phosgene is the most common. This chemical has, at first sniff, a not unpleasant odor, something like green corn. But beware, for death is in that odor. Gas masks are adequate protection against it, but if masks are not available, persons may ride out a chemical attack very safely simply by going indoors; shutting all doors and windows, and putting out fires; the gas is not explosive, but fires create in-

The laying down of an actual gas attack, from portable firing cylinders, is shown above. At right, gas-proof clothing used by soldiers of a Chemical Warfare decontamination unit.

coming drafts. In half an hour, at the most, it is safe to go outside; this gas dissipates very quickly.

Another type of military chemical is the vesicant, most commonly mustard and Lewisite; particularly the former, since it is cheaper. These are not gases, but heavy liquids that lie on the ground and evaporate slowly. If ever you discover such an area, characterized by a heavy, mustard-like odor, get away from it immediately, and notify the proper authorities. If any of it has touched your body, or you think perhaps it has, first call for medical aid, and while waiting, take a good hot bath, preferably a shower.

It is important, however, not to get in a panic about exposure to vesicants. They are poisonous, if breathed for a long time or in very high concentrations, but their main purpose is not to kill but to incapacitate. When they contact any part of the body, especially a moist part, they produce burns, similar to a mustard plaster burn, only much worse. These burns are serious, and require a long while to heal, but seldom have permanent or fatal consequences, except when neglected or very severe.

The other types of poison gases come and go very quickly, but these vesicants are what is known as "persistent agents." That is, they stay around the area affected for a long time. Such areas should be avoided carefully by all except those specially prepared to neutralize them. This preparation consists of special masks, clothing, gloves, and

[*Continued on page* 160]

The Pan-American Highway starts with the main street of Fairbanks, Alaska, (above). The Army is now connecting it with Canadian roads, leading down the West Coast to Washington, shown right.

DRIVING DOWN TO RIO

In California, a special road is being built (below).

WITH completion of stretches of highway in Alaska and in Panama, which Army engineers are working on at top speed, you will be able to drive from Fairbanks, Alaska, to Rio De Janeiro, beautiful capital of Brazil—on 13,700 miles of the Pan-American Highway! MECHANIX ILLUSTRATED presents here four pages of pictures snapped along the route of this, the longest single highway in the world.

The road connects with Mexican Route No. 1 at Laredo, Texas, shown below.

The 1,075 miles from Mexico City to Guatemala City is in spotty condition. But the highway from Guatemala to San Salvador (top), is as good as any first class U. S. highway.

Rio De Janeiro

Excellent highways extend through Colombia, South America, as the photo above, taken near Bogota, shows.

An Indian highway worker takes a "breather" from the road gang.

Some stretches of the highway through Bolivia are difficult (below), but they are being improved at present.

La Paz

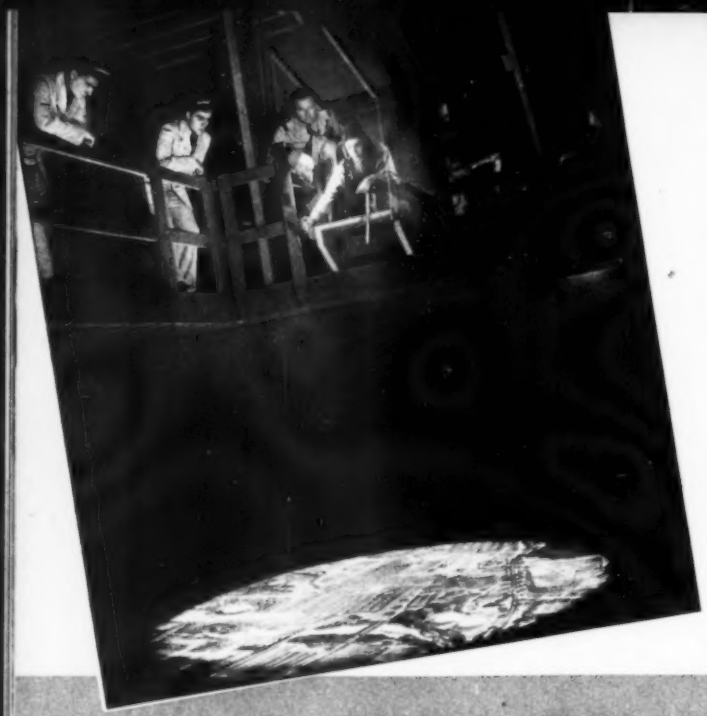
Rio De Janeiro, end of our journey! The beautiful Copa Cabana beach.

Top of the world: The Uspallato Pass, where the highway crosses the Andes. Elevation: 11,500 ft.

Rio De Janeiro

Buenos Aires

The main street of Buenos Aires, capital of the Argentine, 2,134 miles from terminal at Rio.



WITH thousands of new Air Corps recruits busy learning the science of aerial map reading, Americans are just beginning to discover what a curious jig-saw puzzle their earth is from the air.

With this discovery, we are just realizing that there actually is a science to the reading of aerial photographs. It's a science that calls for sharp eyes and careful observation.

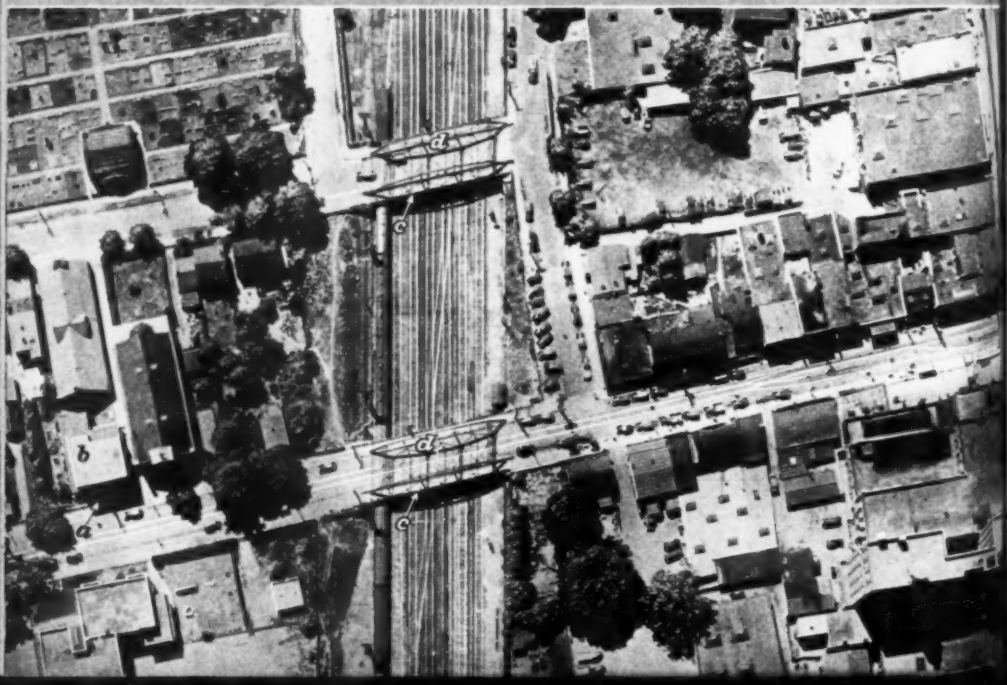
RCAF student fliers are taught map reading by means of the weird-looking contraption pictured on this page. Seated on a balcony, they peer through a bombsight

RCAF students, at left, are taught how to read an aerial map. Look for the tell-tale shadows in map below.

SPOT THE SHADOWS!

The game of reading aerial maps is fascinating. Here are some of the simpler rules.

by Waldo Wright



while a motion picture machine projects a moving aerial map on the floor about 15 feet below them. The students are taught the secrets of the art and, at the same time, operate a bombardier's release and attempt to hit definite targets on the moving map. A mechanism automatically makes the proper allowance for the student's theoretical altitude and delays the "bomb" long enough to compensate for its theoretical fall. Then a pencil of light stabs out and hits the moving map where the theoretical bomb would have struck.

For civilians who wish to learn something of the fascinating game of aerial map reading, here are a few simple principles to remember:

First of all, you must learn to spot the shadows on your map.

Aerial maps are taken on clear days. Buildings, trees and hills cast long revealing shadows. These darkened areas reveal the story of the aerial map.

To read an aerial map, swing it around so the shadows point toward you. Imagine you are sitting high above the earth in a plane flying toward the sun. Let's look at an aerial picture snapped over a Midwestern town, taken at about two thousand feet (shown on opposite page). A six-line railroad track splits it into two panels. Two bridges span the tracks. Note the stores, warehouses, and even the cemetery in the upper left corner.

The shadows make the outlines of the bridges more distinct and highlight the cars parked along main street. The tops of the trees look like sponges. This Midwest town feels sweltering weather, as ventilators on the roofs of the stores and factories disclose.

Now let's zoom up to a higher altitude and take a picture of a quiet countryside. At ten thousand feet, as the plane levels off, the camera clicks. And later the map on this page is what we see.

The aerial photograph on the opposite page was taken at 2,000 feet. The photo above was taken at 10,000 feet. Can you tell which of the two joining rivers is mud-laden?

We see a river with two spurs like a giant letter Y curling off to the left.

Note the glossy white surface of the main stream, (J). Since this indicates that its surface reflects light, this river is probably coffee colored by heavy rains.

But the branch, (K), is dark. This tributary is slower-flowing and clear. So from the air, white is sometimes dull, and dark is clear.

From this high in the air the tree tops of the

[*Continued on page 154*]

Mine Throwers - - The A

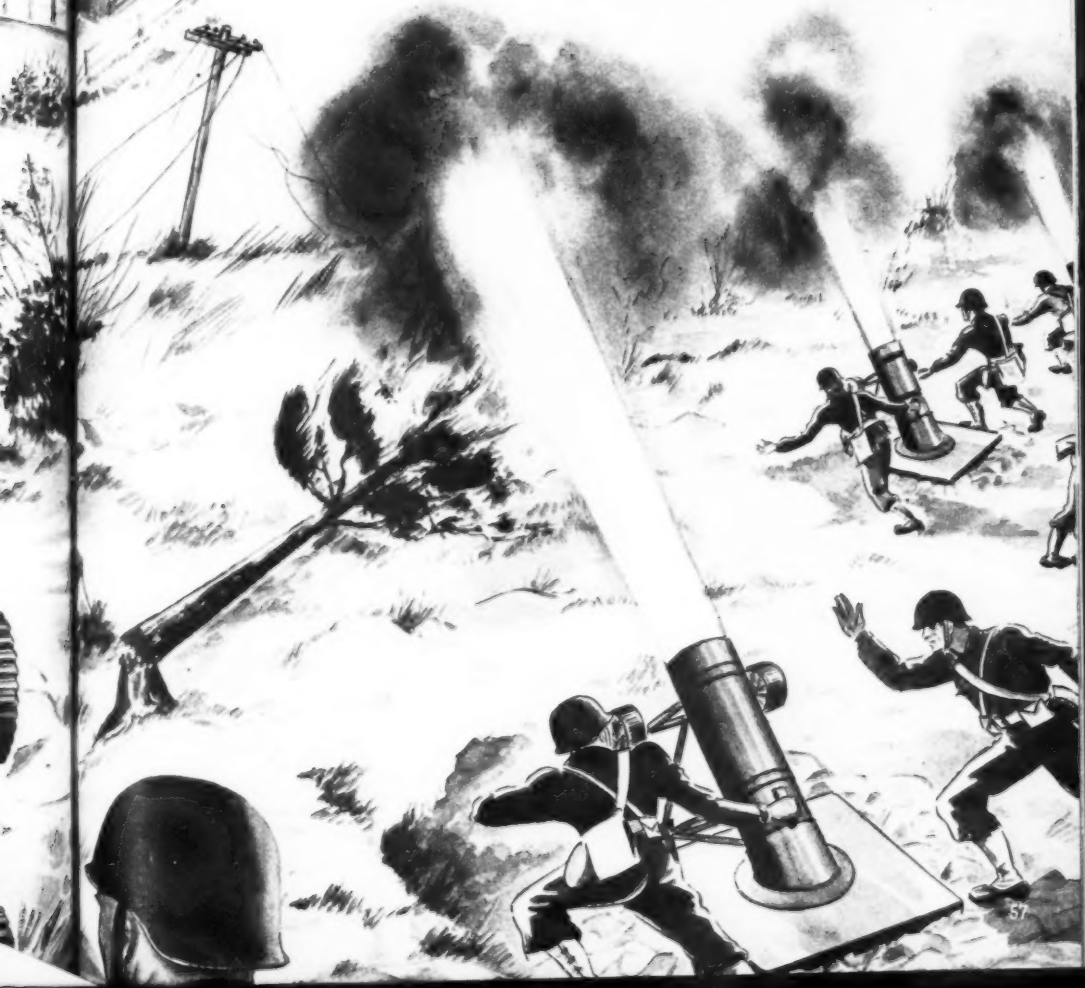
e Answer To The Tank

Mr. Ley, weapons expert for the newspaper PM, pleads for heavy mortars to blast Fascist Panzer divisions.

by Willy Ley

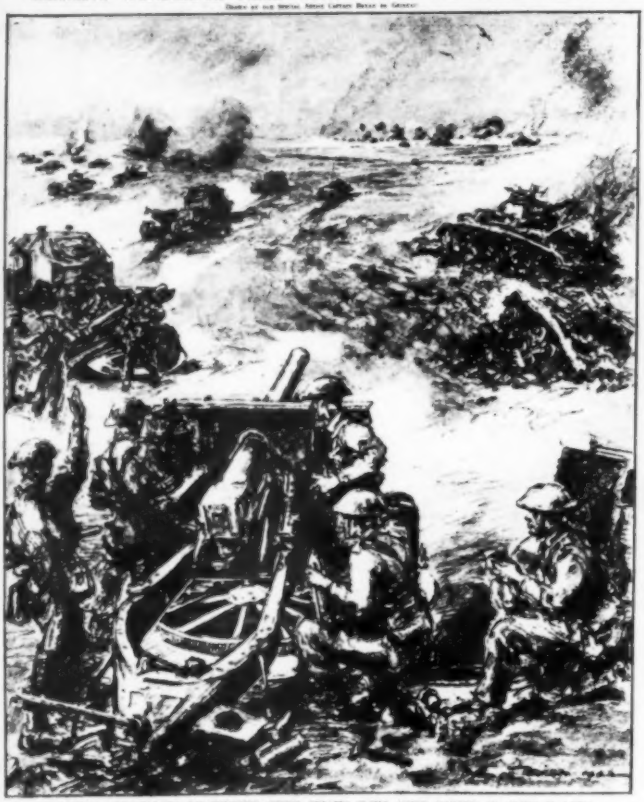
War Weapons Expert, Author of "Bombs and Bombing," etc.

IF THE British had had large numbers of heavy "mine-throwers" at Kuala Lumpur in Malaya, they probably would have prevented the Japanese breakthrough at this point and Singapore would not have been lost. Likewise if the Greeks and Australians had had many heavy mine-throwers at Thermopylae they might have succeeded in stopping the German Panzer Units at that point. And, conceivably, the French may have succeeded in preventing the now famous German "Breakthrough at



THE ILLUSTRATED LONDON NEWS

BRITAIN'S WONDERFUL FIELD GUN: THE 25-POUNDER IN ACTION.



A BRITISH HIGH-VELOCITY GUN-HOWITZER WHICH CREATES HAVOC AMONG PANZERS, IN ACTION IN LIBYA.

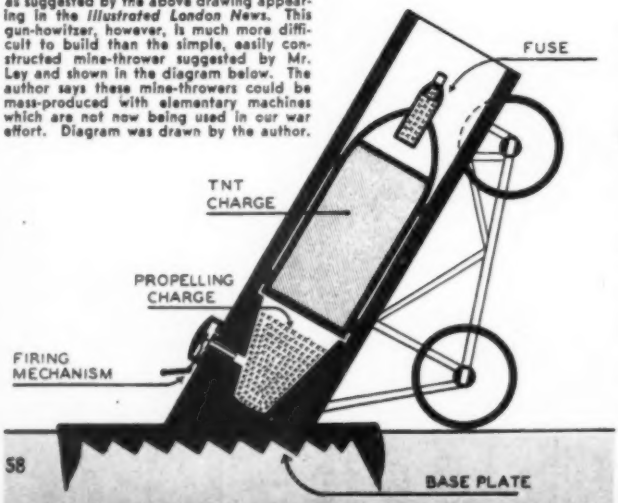
Sedan" which started the Battle of France.

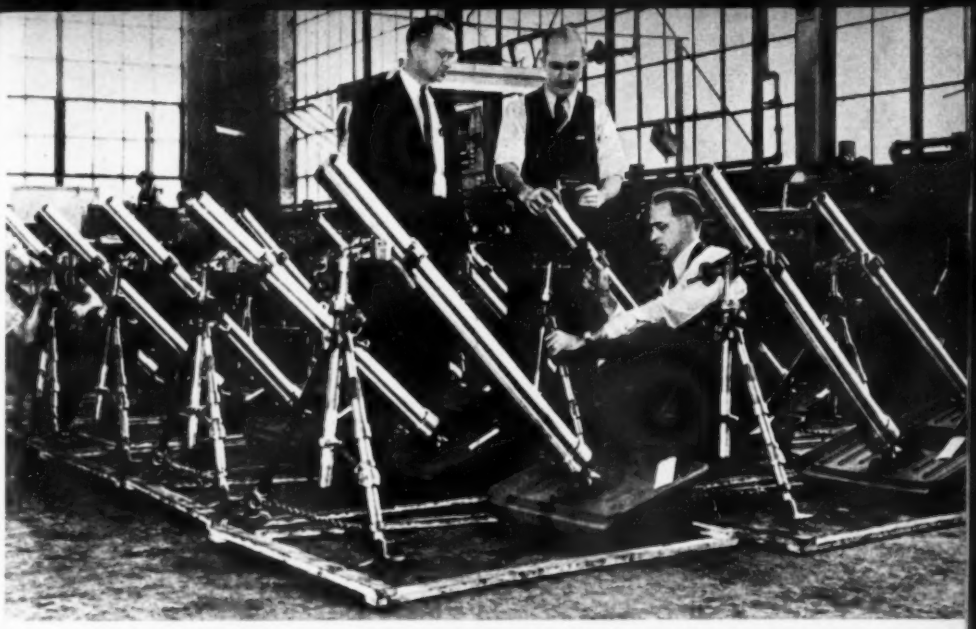
It has to be said, however, that at present there is no such thing as a heavy mine-thrower. The term is to mean a weapon which amounts to a very heavy cannon for short range work, cheap and easy to manufacture in large quantities, just as cheap and easy to operate and accurate enough to halt the advance of an armored column with sufficiently dense fire.

Such a mine-thrower might prove, against present tank attacks, to be as effective as machine guns were against infantry attacks in the last war. It was the machine gun and barbed wire that broke up mass foot soldier attacks. The mine thrower, highly mobile, susceptible to quick mass prdouction, and vastly destructive, might well be the answer to the Panzer. The British have recently discovered that a newly developed gun-howitzer, firing a 25-pound shell, and highly mobile, has created havoc among Panzers in Libya. This is an idea in operation that approaches the idea herewith presented for a mine-thrower. It seems apparent that the mine-thrower would have even greater advantages than the new British gun-howitzer.

While such a weapon does not exist at the present time—at least not to my knowledge—two different weapons that came rather close were in use during the latter part of the first World War and there

The British are discovering the value of a mobile howitzer gun in fighting tanks, as suggested by the above drawing appearing in the *Illustrated London News*. This gun-howitzer, however, is much more difficult to build than the simple, easily constructed mine-thrower suggested by Mr. Ley and shown in the diagram below. The author says these mine-throwers could be mass-produced with elementary machines which are not now being used in our war effort. Diagram was drawn by the author.





Pullman-Standard Car Manufacturing Co., is making the trench mortars shown above. It could make mine-throwers as easily.

still exist some that are constructed and function along the same lines, although their dimensions are much smaller.

The World War weapons referred to were the British Livens Projector and the German *Minenwerfer*. The present day weapons are the British and American trench mortars.

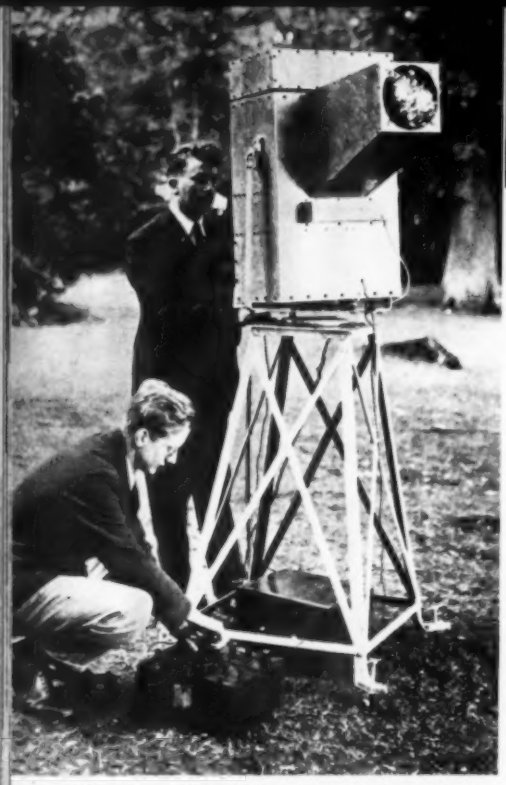
But before going into detail about the proposed heavy mine-thrower it is necessary to survey as quickly as possible a development that took place during the first World War. It began with the re-introduction of one of the oldest weapons, the hand-grenade that was thrown into the ranks of the enemy. Originally containers of explosives that were tossed at the enemy were of two types, one oblong and one round. The oblong ones were called "bombs" and the round ones "grenades." Things developed in such a manner that finally the oblong "bombs" were fired from cannon only (they were the forerunners of present day artillery shells) while the round "grenades" were thrown by specially trained soldiers, the grenadiers. Since it needed much courage and strength to handle the tricky grenades effectively the grenadiers soon acquired a special reputation as daredevils and elite soldiers.

The name of grenadier persisted into modern times, but they did not throw grenades anymore . . . until hand grenades were again introduced as a weapon of infantry soldiers generally. Two types of hand grenades were developed, the offensive type, like the German "potato masher" which contains a large high-explosive charge in a thin-walled container and the defensive type, like

[*Continued on page* 158]

Photo at right shows the vast complexity of recoil and loading mechanism on a field gun. Mine-throwers eliminate this.

Noctovisor



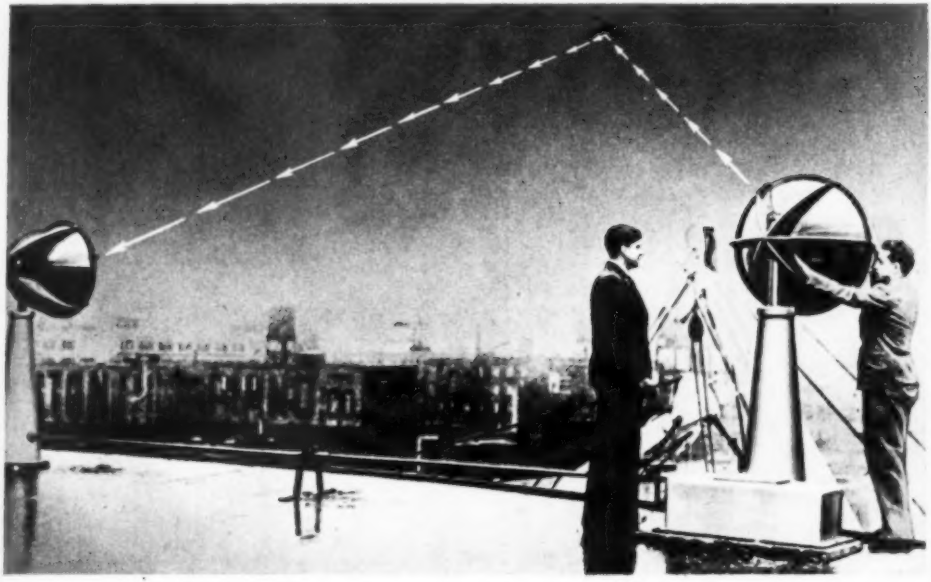
The Noctovisor is pictured above in an early stage of development. Below is a diagram showing how Noctovisor rays are shot up to spot a plane at night. Receiver is at left.

THE night was black as pitch as the British cruiser and its two-destroyer escort plunged through the dark waves of the Mediterranean, off the Libyan coast. They were running at full speed, blacked out, on night patrol to ward off any Axis attempts to land reinforcements for General Rommel's tank troops.

The watch might as well have been blindfolded, for all his eyes were worth in the soupy dark. A layman on board would probably have considered the night patrol a futile game of blindman's buff.

Yet suddenly in the control tower a loudspeaker rumbled, "Enemy cruiser off the port beam!" The British cruiser's guns roared into action, blazing away at the enemy cruiser and its merchantman convoy with the same accuracy that would mark an engagement in full daylight!

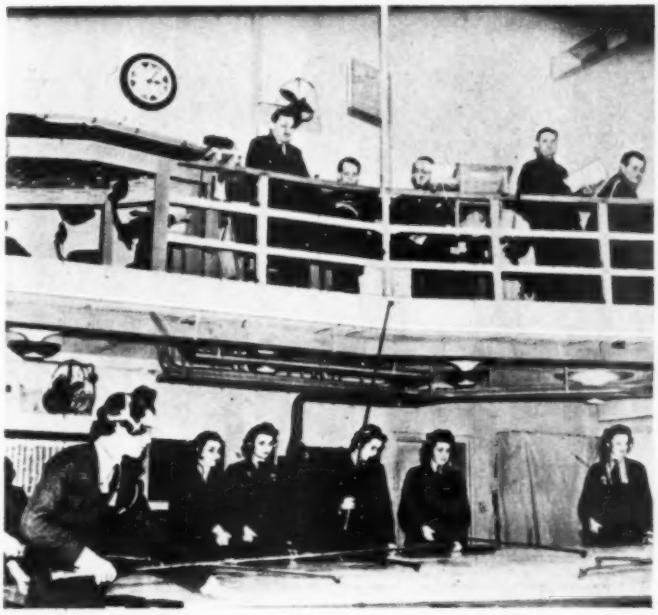
How is such a thing possible? How can men see in the dark well enough to fire accurately? The answer lies in an old invention which has been improved and made new since its value in warfare has been discovered —the Noctovisor.



—Eye in the Dark

A strange new television weapon developed to pierce fog, smoke screens and black of night.

The modified television tube shown above in parabolic reflector is the heart of the new Noctovisor device.



An airplane spotting headquarters in Great Britain. Noctovisor direct wires go to spotting centers.

The Noctovisor is actually an eye to see in the dark. It is based on a combination of the principle of television and infrared scanning. It "sees" not only in the dark but also through dense fog or a smoke screen.

Infrared rays have approximately 16 times the fog-penetrating power that visible light has. The longer the wave of light, the greater its power to penetrate fog or smoke. This fact explains why the sun seen through a fog appears to be red—it is because the fog filters out all but the red rays of the sun. It is for a similar reason that the sun appears to turn red when it sets. Only the red rays can penetrate the dust particles and water particles in the thicker layer of atmosphere through which the sun is seen at sunset.

The inventor of the Noctovisor, John L. Baird, noted English television inventor, took advantage of this fact when he designed his eye in the dark. First of all, he devised a modified television scanning "eye" which was sensitive to infrared light only. Then he connected this televisor by direct wire with a television screen.

When the televisor was pointed into a fog, the invisible infrared rays which penetrate the fog were picked up and transmitted to the television screen, where objects obscured by the fog appeared as if by magic. By this means, for instance, a televisor could be placed on the bow of a ship during a heavy fog and the receiver-screen could be placed in the helmsman's cabin, so that the helmsman could plainly see any object looming up ahead of the ship on the television screen—even though the fog prevented him from seeing anything at all with his naked eye.

Mr. Baird conducted his first demonstration of his modified televisor in England. A group of scientists sat in a pitch dark room

[*Continued on page* 154]

What Is a Machine Tool?

FOR the last year and more Americans have been hearing and reading, "We can't get those guns—or planes, tanks, or vital engines—for another eight months or a year . . . it'll be that long before the machine tools are ready!" Puzzled and dismayed, Americans who've never seen a machine tool have consequently been asking what they are and why they are so important to national defense.

Yet machine tools, vital basis to war production, are no cloudy, abstruse subject requiring rolls of blueprints and Einsteinian mathematics to understand. You know how a carpenter goes about making a chair or table? A machinist makes an engine or pump in essentially the same way, by shaping its individual parts.

The carpenter and machinist, in making anything, first cut each part to the desired form and size. The carpenter works in wood,

Crucible Steel Co.

A machine tool
TURNS

The turning machine, commonly known as the lathe, is the daddy of the machine tool family. Its principle has been known since civilization dawned. A machine tool lathe removes metal as a carpenter's lathe shaves off wood, the metal part being rotated and the cutting tool pressed against it, as here. For multiple production, six lathes can be built into one, to complete a bomb fuse part every 15 seconds. Here the operator guides the cutting tool as the part is rotated.

Nat'l. Machine Tool Builders Assn.

A machine tool
BORES

Everyone knows what boring is—it's cutting a round hole. Simplest way is drilling. Drills are used mainly to cut holes in solid metal. A boring cutter (a single- or double-edged cutting tool on a supporting shaft) trues up or enlarges a hole already existing. It's used where a hole has been roughed out with a drill, or in rough castings or forgings. Here the boring cutter is a single-edged tool truing up a hole in a forged steel part to be used in an airplane engine.

which is comparatively soft. He can use hand tools—a saw, a plane, a chisel, a brace and bit, sandpaper. But the machinist works in metal, usually steel, which is hard. Hand tools for him would be slow and laborious. Human muscles do not have the power to cut steel rapidly.

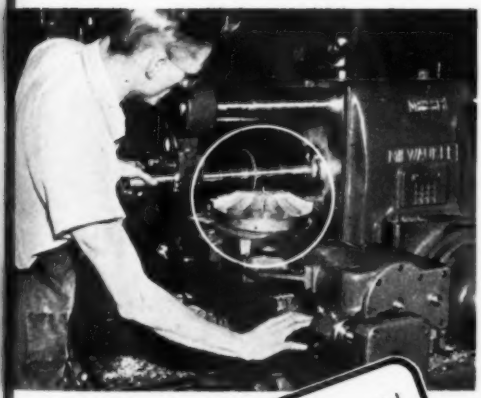
So men have invented machines to do the work of cutting metal. These put mechanical power instead of muscle power behind metal-cutting tools. Hence they are called "machine tools."

Their invention paved the way for our industrial civilization. They not only cut metal more rapidly than hands could, but more accurately. And accuracy proved as important as speed. How difficult it is to cut metal to precise dimensions with hand tools is illustrated by a classic story. For 10 long years James Watt struggled to get a cylinder bored by hand accurate enough to hold steam. Not until a pioneer machine tool was built for this purpose did he succeed in his steam engine invention.

Machine tools' cutting metal to more precise dimensions led to discovering the principle of interchangeability of parts. At

A machine tool
PLANES

Planing with a machine tool is like planing with a carpenter's hand plane. Here a cutting tool is held stationary and parts to be planed are moved back and forth underneath. Shapers reverse the process: parts to be planed are held stationary. Planers are commonly large, some planing pieces 20 feet wide, 30 feet long. Great skill is demanded of planer-operators. Cutting even a few thousandths of an inch in even enormous metal parts would be a very costly error.



A machine tool
GRINDS

If you remember the scissors grinder man, you know the fifth type of machine tool. The grinding machine shapes a metal piece against a rotating abrasive wheel. Grinders clean sand and scale from rough parts as they come from the foundry. They also shape steel parts too hard for machining by cutters. But grinders' most important use, as here, is in removing the last fraction of a thousandth of an inch from parts that must be finished to highly accurate dimensions.

machine tool
MILLS

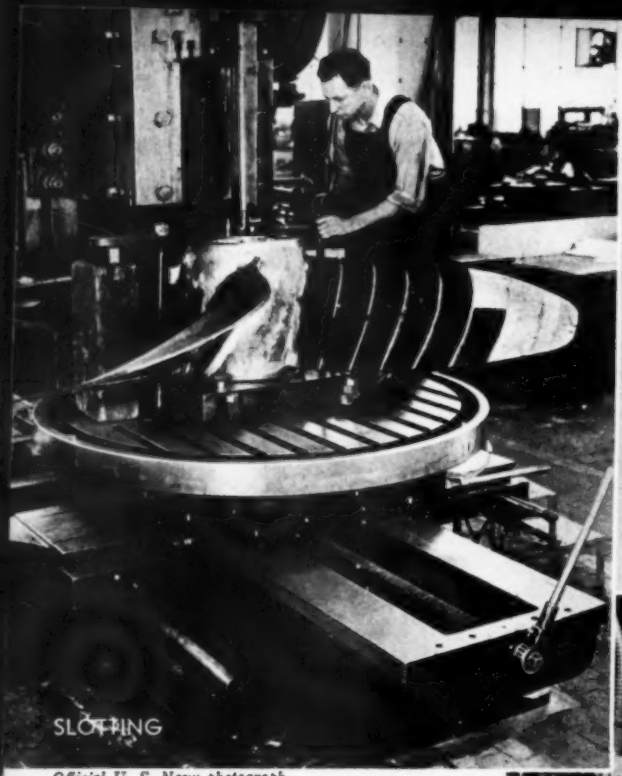
Milling consists of machining a piece of metal by bringing it into contact with a rotating cutter with multiple cutting edges. These edges may each be a single point, making the cutter look like a saw, like the one in the photo here working on a plane supercharger part. Or they may have spiral edges, making the cutter look like a huge screw. These are called helical milling cutters. Milling machine types vary widely, according to various kinds of work they're to do.

photos on this page courtesy Nat'l. Machine Tool Builders Assn.

first, all parts of a rifle, for example, were made for that one particular rifle. Its trigger or barrel, scraped and filed and hammered to fit together as one effective weapon, would not necessarily fit another.

But about 1800 Eli Whitney astonished our Secretary of War by showing him piles of rifle parts so accurately made on machine tools that any part would fit any rifle. And Whitney assembled completed rifles from these parts. Thus was born the American principle of mass production.

When the defense program was launched, we had tens of thousands of machine tools. But vast quantities more were needed at once. Why? First—our war-time


SLOTTING

Official U. S. Navy photograph

HOBBING

Westinghouse Elec. & Mfg. Co.

PROFILING

Boeing Aircraft Co.

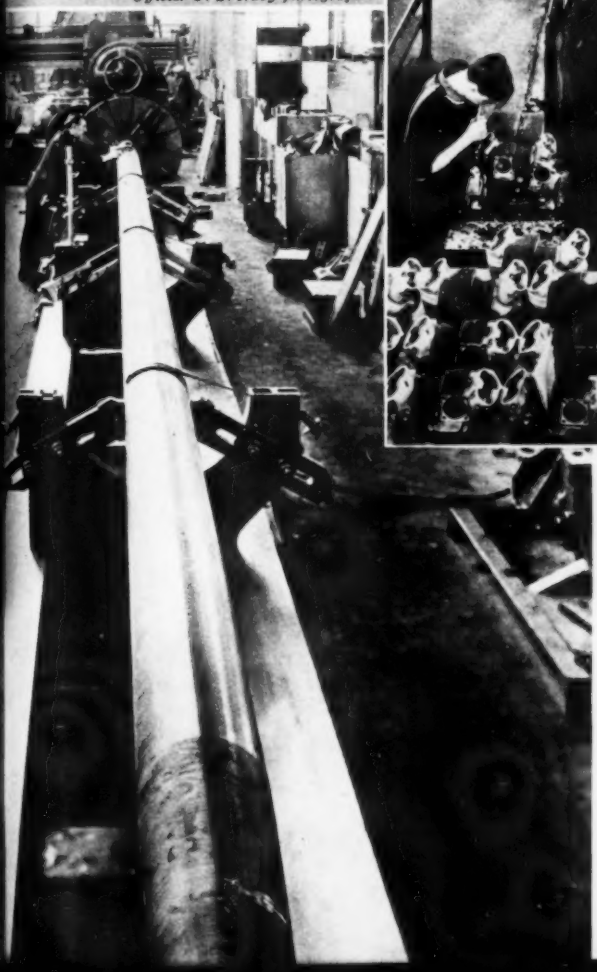
Some Machine Tools Are VARIATIONS and COMBINATIONS

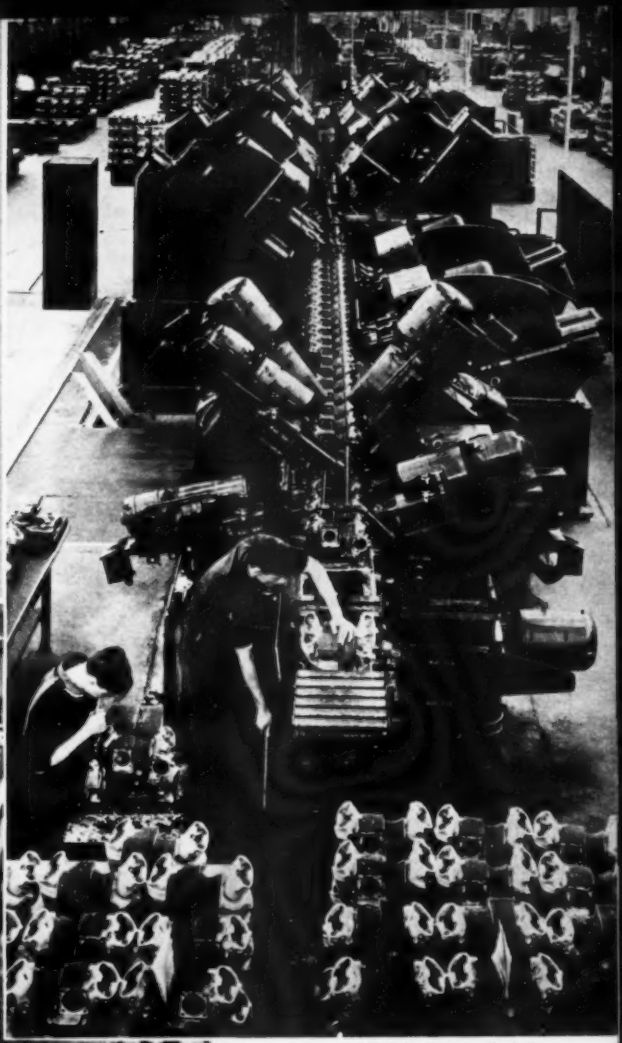
Technically, a machine tool is "a power-driven, complete metal-working machine, not portable by hand, having one or more tool or work-holding devices and used for progressively removing metal in the form of chips." A steam hammer is, therefore, not a machine tool although machine tools were used in building it. The same applies to presses, metal shears, forging and stamping machines. They do not remove metal in the form of chips. More than a century of developing machine tools, most of it in recent decades, has resulted in variations and combinations of the five basic methods of cutting metal. Milling machines particularly designed to cut gear teeth are called hobbing machines. In some cases better gears are now made in 1/20th the time true during the last war. The profiling machine cuts three duplicate parts at once, a slotting machine cuts a keyway in a submarine propeller so it can be fixed to the driving shaft. It's in the design and construction of variations and combinations, which are limited only by the ingenuity of machine designers, that we excel the world.

production volume is fantastically great. We need thousands of tanks a month—each has 15,000 individual parts. Most must be machined on machine tools. Second — many machine tools could not be adapted to defense work. They were not accurate enough, perhaps. Moreover, many operations in defense production had no counterpart in peace-time and required special new tools.

"Machine tools" is a general term, like "agricultural implements." A hoe and a thresher are both agricultural implements, but little resemble each other. So with machine tools. All remove metal, but there the likeness ends. What these vital units in production are is told pictorially here.

Official U. S. Navy photograph





Wright Aeronautical Corp.

Many Machine Tools Are GIANTS

Machine tools may be light and small enough to mount on a bench, or giants of hundreds of tons. The engineering marvel above, 154 ft. long, is 33 machines in one. It drills, taps, bores, faces, and reams aircraft engine cylinder heads. It's entirely automatic—the operator feeds cylinder heads at one end, takes them out at the other. Control panel with 99 indicator lights instantly points out location of any trouble. Before this machine was designed, its work was done on 39 separate machine tools. Time saved: a half hour on each part. The engine lathe at left is turning the outside diameter of a sub propeller shaft.

A BOMBER is droning along four miles above the blacked-out countryside of an enemy nation. Suddenly a motor falters. An oil line is leaking and tongues of flame are flashing through the nacelle and wing structure . . . a trail of black smoke is pouring from the vents. The pilot reaches forward, pulls a handle, and the black smoke gives way to a trail of white gas. The fire is out and the plane returns safely to its field.

A minor miracle of modern aviation has prevented destruction of $100,000 worth of military aircraft and another $100,000 worth of crew. A steel bottle of the gas that puts the pop in soda pop has conquered one of the aviator's oldest and most dangerous enemies—fire in the air. Today, fire is no longer such a serious threat to civilian and military flying safety, thanks to the discovery that harmless and non-poisonous carbon

Bottled Warfare

Smother a fire? Supply oxygen to an aviator? Small steel bottles of gas do it—and become a war weapon.

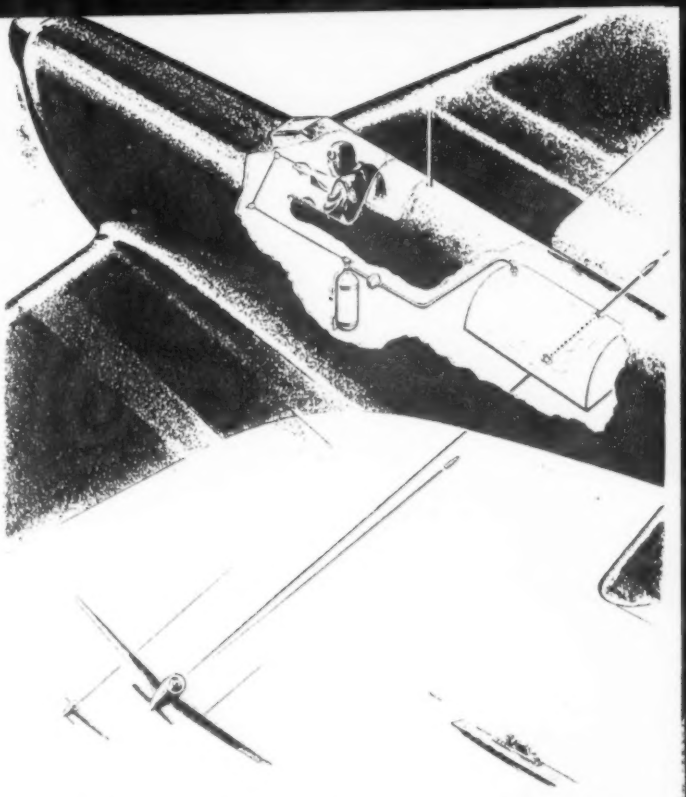
Carbon dioxide snuffs out an airplane engine fire during full flight. Warned by flame detectors, the pilot pulls a dash control, discharging gas from a steel bottle into the blazing motor. Despite the blast of air entering the cowl, the carbon dioxide reduces the oxygen content below the combustion point.

dioxide gas was sure death to that physical phenomenon we call fire.

Because it dooms fire, bottles of CO_2 are now an important weapon in warfare. A safety device or technique that will save the lives and equipment of their own men is ranked as highly by military officials as one which means the death of enemy soldiers. That's why anti-fire bottles of carbon dioxide are not only equipping planes for emergency service in the air, but are being used throughout aircraft factories, on crash trucks and at all landing fields and everywhere else their smothering pall may foil the set fires of arsonist saboteurs, or the flames breaking out through carelessness or mishap. Perhaps if these steel bottles had been at hand, the *Normandie* could have been saved . . .

Bottled carbon dioxide may save lives in another way when a plane is forced down, or a ship sunk. New life belts and rafts and collapsible rubber boats depend for quick inflation on this most versatile of the air's components, compressed into small containers attached to the emergency rescue items.

Warfare safety is bottled, also, in the case of another major component of the air we breathe—oxygen. Compressed into small steel bottles, oxygen for hours of flying can be carried by pilots of fighter planes "going upstairs" above 15,000 feet to attack high-flying bombers. But car-



Explosion-proof gasoline tanks were made possible by an ingenious device which feeds carbon dioxide into the tank as a pilot enters combat. The CO_2 makes the explosive vapors inert, thus they are immune to tracer and incendiary bullets. (Below) Many rescued RAF pilots thank the steel bottle which inflated a rubber dinghy thrown from their plane when forced down.

This war's fighting in rarefied air depends on oxygen cylinders, now made resistant to even armor-piercing shells. Old containers splintered; such fragmentation was as feared as the bullet. (Right) Tiny soda-pop (CO_2) chargers inflate the new emergency life-belts.

bon dioxide is more versatile. You're familiar with it, of course. It's the gas liberated by combustion and fermentation and in some cases comes from deep wells which may have been drilled originally for oil. It can be compressed and liquefied, and in solid form is known as dry ice—a widely used refrigerant.

Physics books don't say who discovered the ability of carbon dioxide to control fire, but persistent legend has it that it was a Swedish harbor master, and the discovery purely accidental. At one of the harbors along the Kattegat an ingenious man rigged a winking buoy whose wink was controlled by a discharge of compressed CO_2 at regular intervals. One night the wind-proof flame was extinguished. Perhaps a storm had loosened a fitting. The leaking carbon dioxide, according to the harbor master's theory, reduced the oxygen content of the air around the flame to the point where it could not burn. This accident opened a great new vista for a product which until then had little commercial value. For that's exactly how carbon dioxide works on [*Continued on page* 156]

Civilians *Can* Fly

CAP pilots above respond to emergency alarm at a New Jersey airport. Left: Civil Air Patrol insignia.

Uncle Sam gives the sport fliers their chance to help America win the war—and they hop to it!

by John Barnes

THE war has imposed restrictions on civilian flying that are drastic.

But they are not prohibitive.

Take as an example the question of who can fly, now that our country is at war?

The answer is amazingly simple. Anyone can fly, or anyone can learn to fly if he doesn't know how already, provided he can prove that he is a true and loyal citizen of the United States.

When war was declared, all civilian flying was immediately stopped. All pilots licenses were suspended. The only one allowed to take an airplane up was an airline pilot on scheduled flight, or a member of the armed air forces. Roosevelt Field on Long Island, one of the busiest centers of civilian flying in the United States, resembled a morgue the Monday morning after Pearl Harbor. There wasn't an airplane in the sky. There was only one lone Stinson Reliant on the line. And that one just stood there, its motor cold. On an ordinary morning at Roosevelt Field you would have seen fifty or sixty planes.

It looked, at first, when war was declared, as though civilian flying was doomed.

But gradually, after the first shock, the absolute ban on civilian flying was relaxed. The first pilots to have their licenses reinstated were flight instructors and student

Hurry call for a propeller is answered by CAP pilot Ed Boroski, Jr., above. New Jersey Wing Commander George H. Vishmann swears in CAP applicant Mae Woodhouse on airport below.

pilots engaged in Civil Pilot Training, or in CPT work, as it is more commonly known.

Now civilian flying is not only permitted — it's wholeheartedly encouraged. The fliers themselves had long been eager to help in the defense effort, and the Jap sneak play crystallized the idea. The result is the greatest civilian flying organization in the history of aviation—the CAP. The full name of this outfit is the Civil Air Patrol, but that doesn't mean that membership is restricted to pilots only. It's true, of course, that a private pilot's certificate or higher is necessary in order to join for flight duty. But the CAP needs mechanics too, just like any other flying organization.

Radio operators are also welcome. Naturally, in all these categories proof of citizenship and loyalty to the United States are required. It's easy to see the service the radio men can be in the type of work planned for the CAP. Patrol duty will be one of the main jobs of the organization, and the ability to report by radio will in many cases be of prime importance. All operators will not be assigned to aerial work, however, as ground men will also be needed. Much of this work will be developed as the organization progresses, and new needs arise.

A membership of 250,000 was originally anticipated, and a large part of it was figured as ground personnel. Among the non-flying members are watchmen to maintain a constant guard over all airports engaged in CAP work, automobile and ambulance drivers, meteorologists, and maintenance men, including the mechanics previously mentioned.

CAP pilots may also be called upon to ferry training planes from the factory to the airport where they're to be used. Then too, if a military ship should be lost or downed, the CAP fliers will have the job of locating it—perhaps rescuing the occupants. When the CAP ship can't get down to the grounded plane, the civilian pilot will report its position, and ground workers will do the rest.

Another part of the CAP's job may consist of rushing vital articles such as spare parts or instruments by air to points where they are needed. In short, the object of the organ-

ization is to relieve every military plane and pilot from work that can be accomplished by a private plane flown by a civilian pilot. As time goes on, the CAP will doubtless take on still more duties whenever practical. There's plenty of work right now—and the men aren't the only ones who can help to do it. The CAP welcomes women in its ranks as fliers or in practically any capacity open to men.

CAP enlistment blanks are available at numerous airports throughout the country, or from the Civil Air Patrol, Office of Civilian Defense, Washington, D. C. Three 1½-by-1½-inch photographs are required as well as the applicant's fingerprints. The general character and record of the applicant must also be clear in order to be accepted.

The minimum age for mem-

THE RIGHT WAY

You won't look beautiful in your full-face blow-up, but that's the only kind of photo CAA will accept. Letter at right tells that flier is a citizen, that's vital.

United States Civil Aeronautics Authority
Roosevelt Field
Mineola, Long Island, N. Y.

Gentlemen:

I have known John B arnes for years. I have known his family for years. His integrity and his honesty are unquestionable.

Furthermore I think he is a great guy. His father used to be in the real estate business, and I know him a way back when.

Very truly yours,
James Thrower

THE WRONG WAY

Photo at right is wrong type. It includes shoulders. "Great guy" letter above won't do—skips citizenship.

REALTY FACTORS OF AMERICA, Inc.
REALTORS
250 PARK AVENUE
NEW YORK
PLAZA 9-3166

WALTER H. SCHMIDT, CINCINNATI, O.
PRESIDENT
H. CLIFFORD BAKER, WASHINGTON, D. C.
SECY-TREAS.

December 11, 1941

United States Civil Aeronautics Authority
Roosevelt Field
Mineola, Long Island, N. Y.

Gentlemen:

The purpose of this letter is to state that I have known John Lorraine Barnes for a period of years. I have been associated with him in business and have also known him socially.

I am sure he is a United States citizen and am also sure that his allegiance to the United States is unquestionable.

I know that Mr. Barnes is a pilot and is at present engaged in a training school at Mineola, Long Island. I understand that his license has been suspended due to the United States Declaration of War, and feel that same should be as quickly as possible reinstated so that he may be in a position to carry out the important work of instructing our future pilots for our Defense program.

Respectfully yours,
Henry Dobbins, Jr.

HDidm

bership is 16, but to be eligible for flight duty, a member must be at least 18 years of age. All flying time must be paid for by the members unless special arrangement is later made by the government. Enlistment is for the duration unless discharged. It is possible, however, for a member to resign with the approval of his Wing (State) Commander.

I was engaged as a flight instructor on a CPT program at the time war was declared. I still am. My log book shows that CPT flying was resumed on December 16, just nine days after the Japanese surprise attack on Pearl Harbor.

After CPT was taken care of, other fliers were reinstated, until by January 8, the necessary forms had been printed in Washington to allow for reinstatement of everyone. So that now anyone who wants to learn to fly, or to continue to fly, may do so provided he is a citizen of the United States.

The procedure is as follows. You must produce for the Civil Aeronautics Authority:

1. Two letters, by persons who have known you for several years, stating flatly that they know you to be a true and loyal citizen of the United States. Letters written on ordinary paper are not sufficient. They must be written on paper with letterheads. And though your doctor, or your bosom pal, may write reams on what a wonderful guy you are, it will do no good, unless he states somewhere in the letter that you are a "true and loyal citizen of the United States."

2. Absolute proof of your birth. The most acceptable item is a photostatic copy of your birth certificate. If you are one of those "steen" thousands of people in these United States who cannot produce a birth certificate, for one reason or another, an affidavit from your parents stating where you were born, and a letter from the Hall of Records stating that they have no record of your birth, will suffice. An old passport, a radio license, or a letter from your sister stating that she knows that "Willie" (who is you) would never tell a lie and say that he is a citizen of his *own* country when he is *not*, absolutely will not do.

3. Two photographs, 2½"x2½", *showing your head only*. But once again a word of caution. Ordinary passport photos will not do. Passport photographs, though they are 2½x2½, will show too much background, and will include your shoulders as well as your head. Such pictures are not acceptable. If you have never seen a blown-up head size of yourself in a cheap photograph, I advise you to be prepared for a shock. You will look like the result of a cross-breeding between Ingagi and a gorilla.

Clearance Officer Roger Knight checks girl flier's card before flight. He's also police deputy.

4. Your old pilot's license. If you have never held a license, in other words you are just learning to fly, then you must produce a student permit. This may be obtained, as usual, from the nearest Civil Aeronautics Authority doctor, who will not be any more strict in regard to your physical condition than he was before the war.

5. Your fingerprints. This is the last thing you have to have. And once again a word of caution. These fingerprints must be taken in the presence of a Civil Aeronautics Authority inspector, and upon a form supplied by the Authority. Usually, when you go to get a license, or go to have your old license reinstated, there will be a fingerprint man supplied by the Authority on duty at the time.

To recapitulate. If you want to learn to fly, or to continue to fly, you must produce:

1. Proof of your birth.
2. Two letters stating you are loyal.
3. Two photographs, 2½x2½.
4. Your fingerprints.

I would say that was simple, for a country at war.

After you have your license, however, there are a few more restrictions.

The most important one concerns where you may fly. The answer is, you cannot

[*Continued on page* 178]

You Can Perform
PLANT MIRACLES

Dr. O. J. Eigsti, right, sprays colchicine on test plants. With it the fertile hybrid, left above, was developed from wild and cultivated cotton species.

by
Ray W. Bonta

Collaborate with science in discovering needed new plant species with colchicine.

HOW'D you like to collaborate with scientists on significant, discovery-making experiments? You can, right at home in your spare time. Besides fun and an absorbing hobby, you may have the thrill of making a valuable contribution in plant breeding.

Miss Eunice Moore, a busy Tulsa, Okla., nurse, experienced that reward not long ago. Her experiments with colchicine on a few plants of soybean at home resulted in a new variety twice as big and heavy as its parent strain. Scientists are watching this promising new variety with particular interest because soybeans loom large in our war-time economy. They supply oil, cattle feed, and plastics, for example, all especially vital to a country at war, and with imports cut off.

Perhaps you can help, too! Already more than 300 amateur collaborators scattered through 38 states are working under the leadership of Dr. O. J. Eigsti, assistant professor of botany at the University of Oklahoma. The roll of his far-flung scientific collaborators includes rich and poor men, doctors, lawyers, housewives, nurses, schoolteachers, ministers, policemen, miners, editors. The scope of the job has brought WPA help, with the approval of the interested Department of Agriculture which is well aware of the significance of the experiments with colchicine.

That chemical is the most important factor in the tasks of this useful hobby. Basic factors are, of course, seeds, plus plenty of interest in the subject of plant-breeding, patience, and willingness to keep your garden-patch weeded. Colchicine is a yellow powder extracted from the underground part of the autumn crocus, *Colchicum autumnale*. It's an active poison, so that caution is necessary in handling it.

Giantism, such as Miss Moore obtained from her colchicine-treated soybean plants,

[*Continued on page* 163]

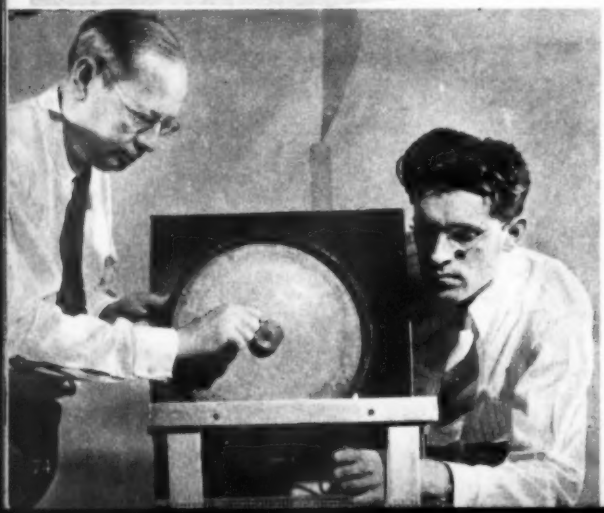
Fingerprinting A Thunderbolt

How man has tamed the elemental force of lightning and pulled all its teeth.

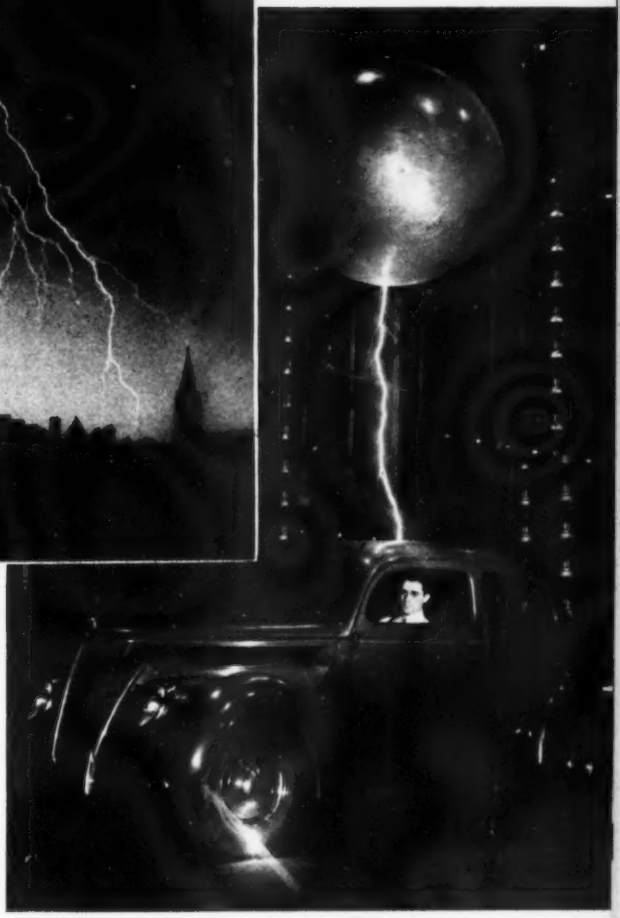
by
Charles D. Bonsted

DID you know that every time you take a breath, 100 bolts of lightning strike somewhere in the world? That 16 million electrical storms occur each year? That lightning is no foe of man, but helps him produce food by fertilizing the soil? That the earth is like a battery and must be regularly recharged? And that—

Well, if you didn't, take comfort in learning that our scientists themselves didn't know elementary, useful facts like those about such a familiar phenomenon as a thunderbolt until fairly recently. Now they're catching up fast with direct lighting studies, for which they're developing new devices that "fingerprint" bolts as they occur, and creating lightning in laboratories, too, in order to



The fulchronograph (left) measures the current of lightning at 1/25,000th of a second.



G. D. McCann, Westinghouse engineer, sits in safety at wheel of car while 3,000,000-volt lightning bolt strikes it. The bolt can be seen jumping over front wheel of the car to reach ground.

hurry up their progress along the road to complete knowledge of lightning's power to do good and harm, its varying make-up, and its controls.

Curious Benjamin Franklin, about whose experiments with a key and a kite during an electrical storm every schoolboy has read, would have been delighted to be taking part in these investigations. He probably would be astonished and chiding to discover that little was learned about lightning for about 150 years after he made his experiments in the middle of the eighteenth century. Yes, man's curiosity about the two billion thunderbolts that streak from the sky each year was as slight as that! But about a generation ago, he was forced to begin research on the subject when lightning damage to expanding electric power systems made an intensive study of the phenomenon imperative. By now, knowledge is sufficient that efficient safeguards against such damage have been developed to protect the complex and vital electrical-power and communications network of modern America. How important that is can be gained from the fact that even momentary power interruption in some types of war industries could spoil a whole day's production, or cause serious delay. It's good to know, then, that the constant threat of damage by sudden, unpredictable lightning has been largely licked. In any case, as suggested earlier, lightning is by no means entirely a frightful villain. If safeguarded, its attacks should be welcomed! Here are two reasons why, the scientists have recently explained:

(1) Action of thunderbolts in streaking through the atmosphere with the speed of 60 million miles per hour, releases nitrogen from the air. In the form of nitric acid, the nitrogen falls in rain drops and enriches the soil.

Through this process, lightning annually produces nearly 100 million tons of nitric acid—more of this soil-builder than manufactured by all the world's fertilizer plants!

(2) Lightning restores the electricity that constantly seeps from earth to clouds, and thus keeps the earth charged. Negative electricity continously leaks into the skies from the earth at the rate of 1,000 amperes—power of about 300,000 kilowatts, or enough to drive 200 submarines. The earth constantly loses and regains its electrical charge because of ionization in the air. Particles in the air which become electrically charged or ionized conduct electricity from the clouds. The engineers state it this way: "Ionization in the air is produced by X-rays emanating from radioactive minerals in the earth's crust, by radioactive gases in the atmosphere, and by cosmic rays from the outer universe." Get it?

Impressed or not, most of us realize we can't

Wave pictures of lightning are shown on the above film recorded by cathode ray oscillograph. At left, a 3,000,000 volt bolt of lightning splits a telephone post wide open.

do anything, even if needed, to affect the falling of nitrogen to the earth or the re-charging of this ol' battery of an earth. What we're interested in mainly are the safeguards the scientists are working out, to prevent costly property destruction, service tie-ups, and war-time power breakdowns.

Many of these safeguards have been developed from the information which has been collected and analyzed at the Westinghouse laboratories at East Pittsburgh, Pa. Here has been built up a file of hundreds of "fingerprints" of lightning. These "fingerprints" are the scars left on wood, metal, etc., by lightning created in the laboratory. Having control of the amount and duration of the electricity put into a fake lightning bolt, the scientists know just what it took to cause a certain scar. The lightning maker in the laboratory is a surge generator which can produce a lightning stroke of three million volts and has sufficiently powerful current to shatter trees and telephone poles and to fire haystacks, wood, and other combustible materials.

When they find the same sort of evidence left by a lightning bolt in nature, they know—like a modern criminologist tracking a suspect—the characteristics of the phenomenon that flashed there long before the marks were found.

"Detoured lightning"—this is how man beats lightning damage to power and communication lines, by de-ion transformer on pole.

A "model" lightning bolt hits a "model" barn in Westinghouse laboratory, with Dr. P. L. Bellaschi, expert, watching it.

Frequently in this process the lightning investigator uses microscope and calipers to measure the extent of melting. Pictures may be taken of the lightning dents, and enlargements made of them for closer study. Sometimes sections of the field specimen are cut to determine the nature of the scars.

Signs of crushing force and shattering indicate "cold" lightning. Melting and burning are caused by "hot" lightning. The former consists of high current but short duration electrical discharges lasting possibly 200 millionths of a second. "Hot" lightning is characterized by low current of long duration, sometimes lasting nearly a second. In lightning discharges to earth, the two appear frequently together in various amounts, the "cold" lightning component followed by the "hot."

Westinghouse's laboratory tests have shown that lightning powerful enough to melt a lightning rod tip no bigger than a pea represents an electrical charge of approximately 200 coulombs. Though this amount of power would light a 60-watt bulb for only seven minutes, it's got whacking force when compressed into a lightning stroke lasting a tiny fraction of a second. Lightning strokes to earth seldom exceed this force, the studies show, and the average stroke is about 25 coulombs. (In case you've forgotten: a coulomb is the amount of electricity transferred in one second by a current of one ampere.)

[*Continued on page* 171]

You're RIGHT — That's WRONG

Here are 25 statements, some of them true, the others false. The trick is to separate the *true* statements from the *false* ones—and it isn't as easy as it looks! Use a pen or pencil and check the correct box under each statement and see how you make out! After you've given yourself the test, try it out on friends and other members of the family and compare scores. They'll enjoy it and so will you.

Are you ready? Let's go!

1. All storage batteries on the market today may be charged either with alternating current or direct current, and deliver either kind accordingly.
   True ☐ False ☐

2. The pistol is named for Pistoia, Italy, where it was invented.
   True ☐ False ☐

3. On board ship, the stuffing box is the container used by the engine room workers to store oily rags.
   True ☐ False ☐

4. In the present war it is possible for a submarine to fire a torpedo today which will strike a ship and explode yesterday.
   True ☐ False ☐

5. Birds are cold-blooded, their bodies taking on the temperature of the surrounding air.
   True ☐ False ☐

6. Like an automobile, a steam locomotive exerts its greatest pull when in reverse.
   True ☐ False ☐

7. Toussaint L'Ouverture is not the name of a piece of music, but of a famous figure in history.
   True ☐ False ☐

8. Photosynthesis is not the name applied to the developing of films by photographic technicians.
   True ☐ False ☐

9. There are only two photographs of Christopher Columbus in existence, and one is only a negative of his head and shoulders.
   True ☐ False ☐

10. A waag is an intelligent green and white monkey.
    True ☐ False ☐

11. Millibars are not the gold and silver insignias indicating the rank of military men, but atmospheric pressure units.
    True ☐ False ☐

12. The zereba is really not a striped animal resembling a horse, and does not gallop like a horse.
    True ☐ False ☐

13. Owing to the position of the propeller at the end of the fuselage on autogiros, they can climb vertically from a standing start without a motor.
    True ☐ False ☐

14. Panchromatic film, although producing a black and white photo, shows colors in their true gray relation, and does not show red as black.
    True ☐ False ☐

15. A back-geared lathe is one which runs in reverse at all times regardless of the direction in which the motor is turning.
    True ☐ False ☐

16. In level flight the tail of an airplane does not support the weight of the airplane.
    True ☐ False ☐

17. A gasoline engine with double ignition has only one sparkplug per cylinder although it always has two carburetors.
    True ☐ False ☐

18. It is possible for an automobile to run on a level road without skidding even though all four wheels are turning at different speeds.
    True ☐ False ☐

19. Scantlings are the light weight shorts worn by midshipmen during the summer months.
    True ☐ False ☐

20. A capstan lathe and a turret lathe are one and the same thing.
    True ☐ False ☐

21. The shaft running from the transmission of an automobile to the rear axle drive is called the propeller shaft.
    True ☐ False ☐

22. When a shipbuilder refers to a spiling he means a ruined piece of lumber, as the word "spiling" was originally "spoiling."
    True ☐ False ☐

23. In Australia, the "land down under," the month of January precedes the month of February in each year on the Gregorian calendar.
    True ☐ False ☐

24. Sailplane pilots look for cumulus clouds, as rising columns of air beneath these clouds help lengthen the sailplane's flight.
    True ☐ False ☐

25. When an airplane is steeply banked at high speed the load on the wings is greatly lessened because the rudder supports most of the weight.
    True ☐ False ☐

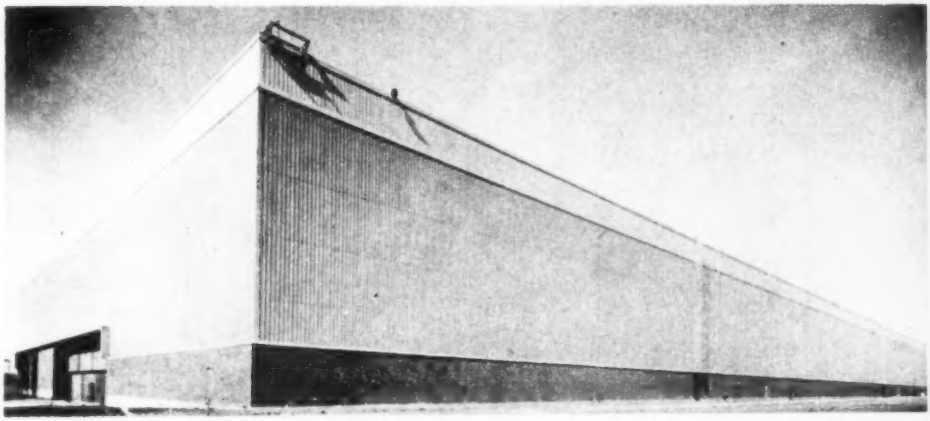
WHAT'S YOUR SCORE?

To get your score simply give yourself 4 points for every question you answer correctly and total the result. If your mark is above 90, you are exceptional; if it is between 80 and 90, you deserve high praise; if it's between 70 and 80, you're good; between 60 and 70, fair; and below 60—well, try again next month!

Answers will be found on page 168

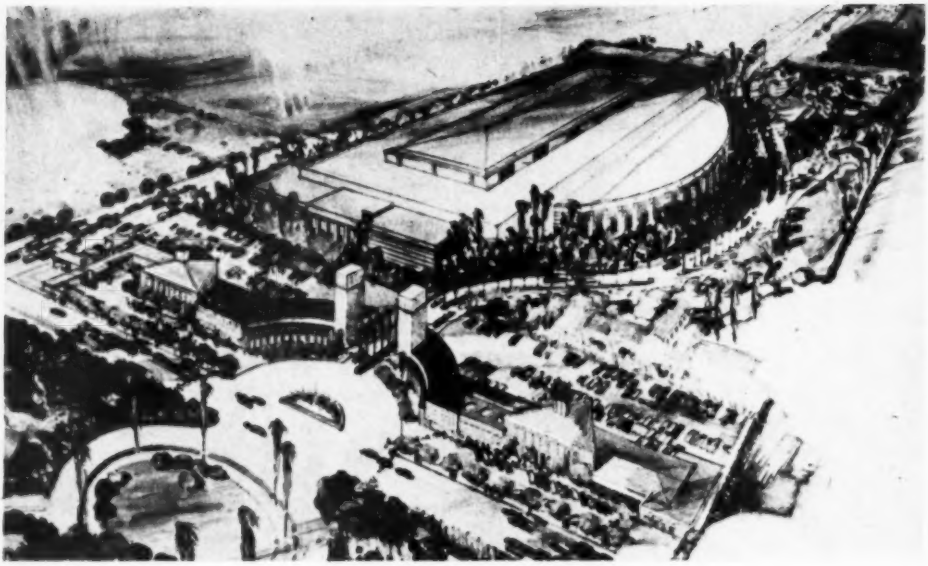
NEWS OF SCIENCE AND MECHANICS

WAR EXTINGUISHES BIGGEST SIGN—SPY SMASHER BESTS BAT PLANE — SUPER-JEEP



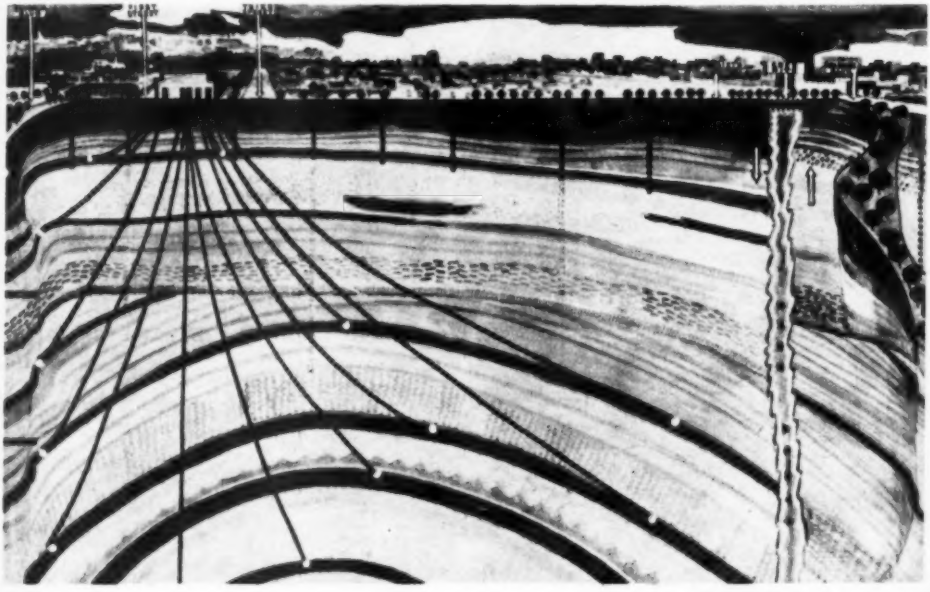
Biggest Room In The World!

A YEAR ago a farm area, today Willow Run is the biggest room in the history of man! Built by the Ford Motor Co. to turn out a four-motored bomber an hour, this workroom is half a mile long, a quarter-mile wide, will have 90,000 workmen busy in December, contains 25,000 tons of steel. Autos are used in running errands!



Auditorium? Library? Nope—Indoor Oil Field

TO SUPPLEMENT war-time petroleum supplies, Los Angeles is considering annexing an old oil field in the suburbs and creating on a part of it the only indoor oil field in the world, within an eight-acre, $3,000,000 concrete building. Noises, gases, and other objectionable features would be confined, yet holes to the various oil levels could be drilled like spokes of a wheel, as far as a mile from the indoor derricks (see cross-section below). Drillings beneath the surrounding 400 acres would pay owners gas and oil royalties without depriving them of the surface's use and sightliness.



Builds Better Mousetrap

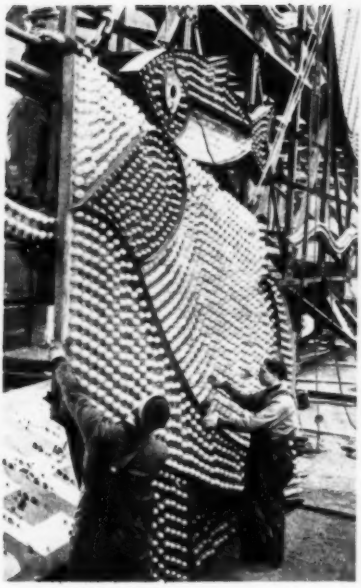
THE better mousetrap for which the world reputedly is waiting to beat a path, may be an inexpensive automatic fire-extinguisher! A small, easy-melting metal strip across the trap catch releases it when room heat reaches 400° F. Snapping up, the catch smashes a discarded electric light bulb containing CCl_4 an effective fire-killing agent. This chemical student at Hope High school in Providence, R. I., holds another version of the idea.

Canny Hobby, Warships

THIS model of the U. S. S. *North Carolina* was one of the 13 which Emanuel Cachia, above, exhibited at the sixth annual American Hobby Show in New York City. A baker, Mr. Cachia uses old tin cans to make his models of warships, converting the containers from the day's fillings for pies and cakes into miniature battlewagons as easily as he whips up a Charlotte Russe. Naturally, the can-opener is one of his most-used tools.

Wires Hold it Now— Soon It'll Hold 57 Men

ONLY thin wires held aloft this preview model of a transport plane recently, but when next on view it will have become a sky-giant, with four motors to hurtle it through the air at a top speed of 350 m.p.h. Designed by Lockheed to carry 57 passengers, it will have a 4,000-mile range, fly at 30,000 feet, and cruise at 285 m.p.h. for transcontinental service. It has a top speed of 350 m.p.h.

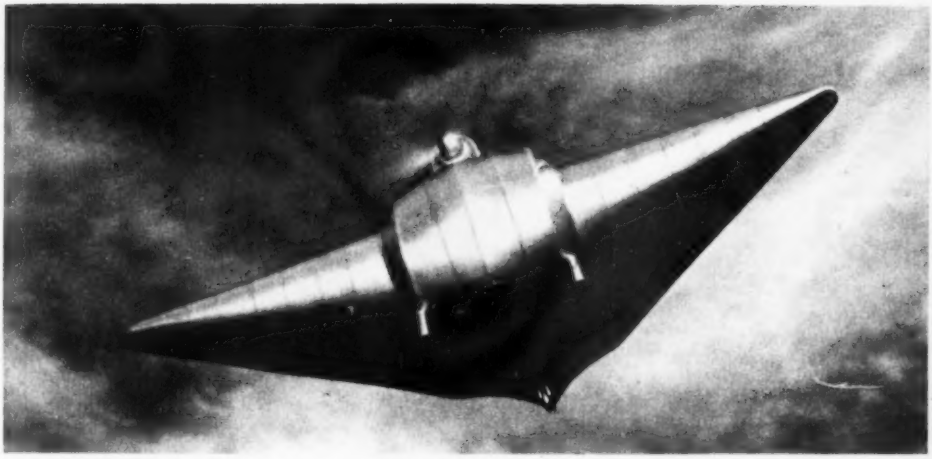


War Extinguishes Broadway's Fishy Night Life

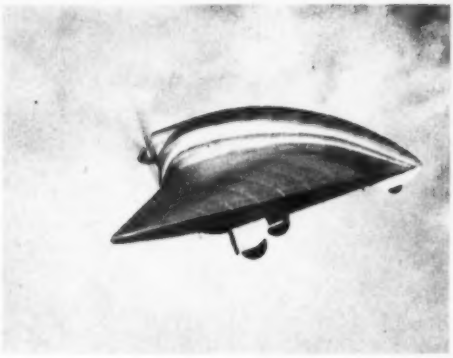
AMONG early casualties of the war, in the estimation of admirers of New York City's Gay White Way, were the giant-sized fish which nightly glowed in fantastic color and life-like wriggles atop a building in the entertainment heart of Manhattan. Comprising the world's largest electric sign, 192 feet long, the finny monsters were victims of the needs for electric power (the display contained 29,508 bulbs), for metal (the steel supporting structure is being sold for war manufacture), and for sugar (confection-makers like the advertiser are not sure of future supplies).

No Rationer's Going To Cry "Get A Horse!" Here

TIRE and fuel scarcities may be sending his neighbors back to horse-drawn vehicles, but not Morris Oglesbee of Xenia, O., the advantages of whose 1898 Stanley Steamer are now widely envied. Tire rationing doesn't worry him; his tires are solid rubber. Water for the steamer must be replenished every 20 miles (there's no condenser) but fortunately is not yet being rationed. "The old boiler," as he calls the car, requires about 12 minutes to develop sufficient steam for starting and needs a gallon of gas every 30 miles to keep the steamer steaming.



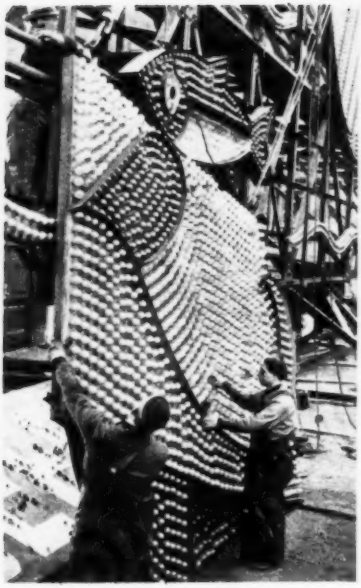
Spy Smasher Defeats Plane



EVEN though the German spy ring in America uses this Bat Plane—an aircraft based on the helicopter and flying-wing—intrepid Spy Smasher defeats their foul purposes, in the 12-chapter movie serial in which the great Fawcett comics character is now starring. The Bat Plane, which can land or rise vertically, and flies through the stratosphere, is used by the spies in escaping Spy Smasher. He overcomes them eventually, though—America is safe with Spy Smasher on the job!

Changing Wooden Tire For Betty Would'n Tire Us!

BETTY GRABLE seems undismayed by the spike sticking out of the white-walled tire on her new sedan—because the tire is wooden and therefore unharmed by glass, curb bruises, and sundry other usual hazards to rubber. As the star demonstrates, all you need is a hammer to remove metal picked up by these tires—yet it's safe to drive as fast as 75 m.p.h. on them if necessary, as tests have shown. Bolted to the wheel, the tires are made of laminated hard wood, would cost from $6 to $10 each, and should give 12,000 to 15,000 miles wear. Best to use them only on front wheels.



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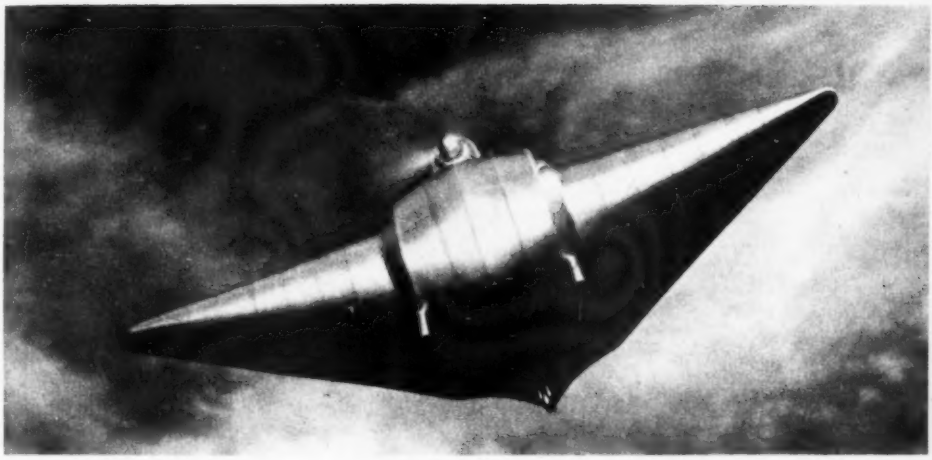

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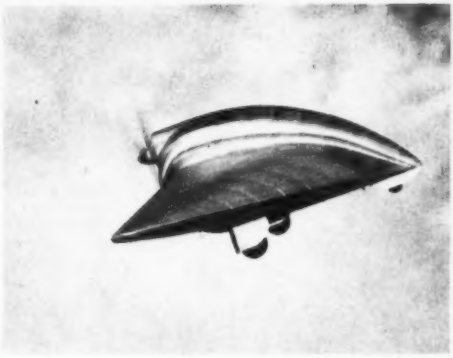

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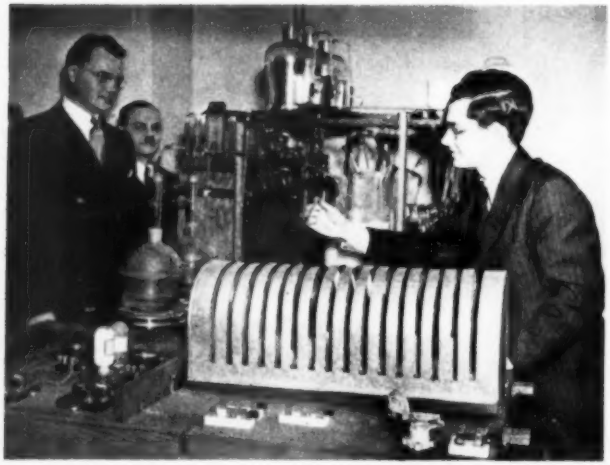
Boo! Said The Sailor

UNLESS the sight frightens away rescuers, shipwrecked sailors in this new rubberized suit stand improved chances of being saved. It's said to keep the occupant warm and afloat indefinitely. Weighing less than 10 lbs., it folds into a suitcase, costs less than old cork preservers, and can be donned in two minutes.

At 5 He Knew The 3 B's

BACH, Beethoven, and Brahms were no mystery to Kenneth Wolf at the age of five. Why, at two he'd played the piano and at three written a song. At four he raced through chemistry textbooks, and mastered advanced chem when six. Enrolled at Western Reserve U., Cleveland, O., he's now 10, the country's youngest collegian!



Youth Shows How To Get 2c Aluminum

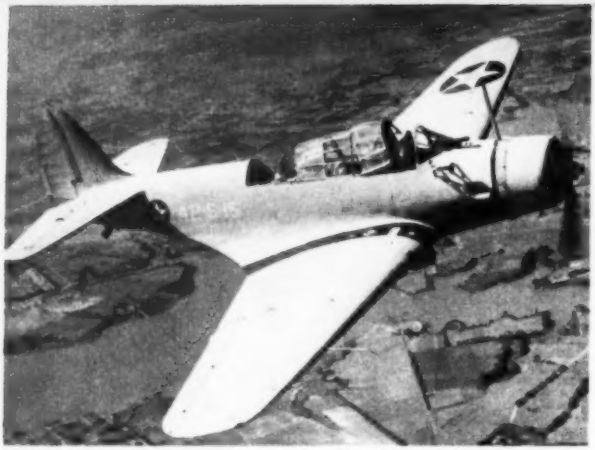
EMULATING the original discoverer of a commercial method of extracting aluminum, Alfred R. Globus, right above, 21-year-old Brooklynite, recently demonstrated a new process based on dissolving clays with sulphuric acid and sodium hydroxide. Industrial trials will test Globus' assertion that 200-250 lbs. of aluminum could be produced from a ton of usable clay for 1c-2c lb.

Peep Takes To The Air

NOTHING as simple as a ravine can hold up the advance of the peep and its ingenious crews at Fort Sheridan, Ill. On maneuvers in the field the peepers were only temporarily baffled by a ravine; then they ran a steel cable between two trees and transported the peep on a pulley arrangement with a truck-mounted winch to do the pulling.

Combat "Plaything" Trains Gunner's Eye

IT MAY look like a kid's playful construction of a bomber's fuselage, but this really is a pre-flight gunnery trainer which gives stimulus to practice and even provides helpful recreation to combat pilots off duty. Seen as especially useful in interceptor stations where pilots must wait for considerable periods between bouts with the foe, the trainer is expected to save air time and increase skill.



Torpedo Bomber: Death To Axis Ships

DOUBLE duty against enemy surface vessels is performed by the Navy's Douglas TBD-1 three-place torpedo-bomber (also on the cover). It attacks ships from high altitudes with its ton load of bombs; or, when just a few feet above the water, aims itself at the target and launches a full-sized torpedo. Heaviest of carrier-based aircraft (9,000 lbs.), the TBD-1 wings fold to half their 50-ft. span.

New 'Panty' Makes Parachuting Safer

SHOWN on a testing ground near Reno, Nev., is a new type of parachute using a center 'panty' to lessen jerking shock when the parachute opens, to slow descent, and to decrease the oscillation which sometimes is dangerous as the chutist lands. Dr. Christian Wolf of New York and Los Angeles invented it. The 'panty' deflects air to the outer edge of the 'chute to spread it quickly.

Jeep Goes Super With Retractable Wheels

ENTER the "super-jeep!" The army's lively, useful little car may receive even harder tasks. This experimental model of an elaborated jeep has a four-wheel rear drive with retractable side mounts to lift the front wheels out of deep ditches and culverts. Here the "super-jeep" carries a crew of four and a 37 mm. anti-tank gun over rough terrain. Capt. R. C. Fitch of the Mechanized Cavalry Reserve designed it.

Private Excels Experts In Inventing New Gun

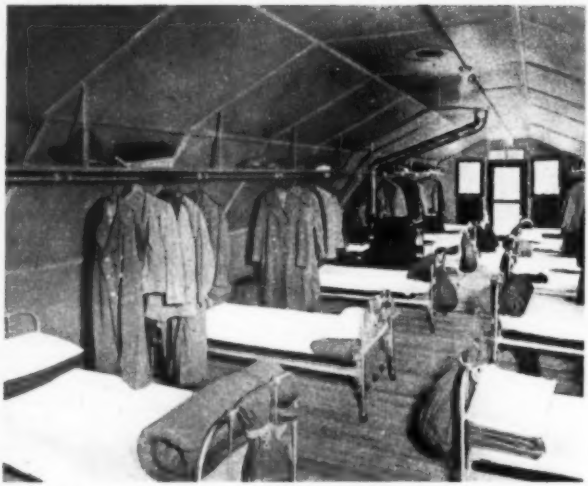
A PLAIN, everyday soldier has invented a new submachine gun worthy of a scientific laboratory or military experimental post. The simple mechanism of this 10½-lb. gun devised by Evelyn Owen, 27, Australian army mortar-mixer, makes it possible to replace hot barrels and spent magazines in seconds. Now being mass-produced, the gun has features making it extremely deadly.

Bald Men Take Note: Plane Grows Test "Hair"

THE hairy tufts on this Army Republic P-43 pursuit plane are not for extra warmth in winter but simply pieces of string fixed on the plane before it goes in a wind tunnel. Movie cameras photograph the tufts' movements in the wind, to determine the pattern of airflow direction. Such tests are undertaken on new models in order to check and improve aerodynamic design.

Kills Germany's E's With Greatest Ease

AS FAST as Germany comes up with a new war technique or weapon, the Allies originate one to slap it into ineffectiveness. One of the new and prime examples is the fast British armored boat shown at right, England's answer to the dread German E-boats (torpedo motorboats) which have been making daring forays against English ships. As fast as the mosquito craft, the E-boat-killers are much more heavily armed and manned.



Two-Headed Nail Means Double Use For Huts

REMOVABLE double-headed nails (above) and self-threading screws permit rapid dismantling of the U. S.' new military hut for re-assembly in another sector, Iceland or Panama! Accommodating 12 men, they are prefabricated of metal.

All Senses Duplicated Without Any Nonsense

GENERAL ELECTRIC COMPANY has duplicated all the five senses. L. to r., sight—electric eye excels nature's; hearing—sound detector is so sensitive it will pick up the noise of a dollar bill falling on the floor; touch—the smoothness gauge; smell—mercury detector smells poisonous mercury vapor the nose can't; taste—this apparatus detects untastable sourness.

Seaplane Pilots' Pal On Land Is Named Dolly

EASY-GOING dolly is the helpful friend of pilots of seaplanes forced down on land, perhaps; or, as in the case of the small aqua-aeroplane here, when they wish to fly the ship away from its inland place of manufacture. The plane's experimental pontoons are set on a dolly and rolled on easy-turning wheels to the field. The dolly stays with the plane until dropped away when the ship is ready to launch into flight. Photos were made at Aeronca Field.

Army Plans Civilians' Wartime Car

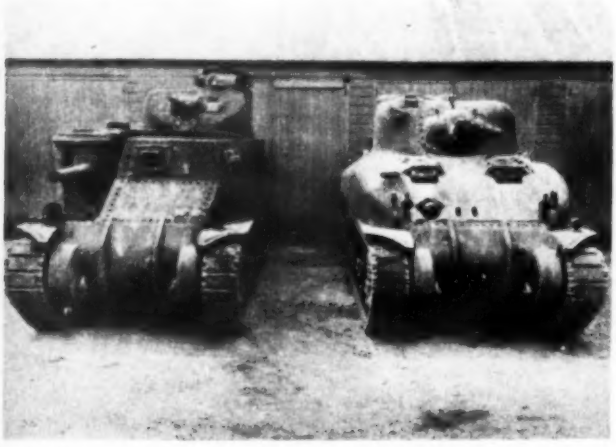
TOUCHED by the plight of sad civilians unable to buy a new car because of metal scarcities and war production in auto factories, Capt. R. C. Fitch of the Mechanized Cavalry Reserve offers this solution of a car of station wagon styling made of plastic and a modicum of new steel. It would use a rebuilt four- or six-cylinder car motor. If it goes into production, the "Victory Car" will be priced at about $600.

What's Cookin'? Bushings?

BUSHINGS, bearings, or whatever the war program requires are as much the product of Mrs. Homer C. Price's kitchen in Columbus, O., nowadays as coffee and omelets. War orders forced her husband's basement machine shop to expand all over the house. Now a separate factory is being built so that the Prices will need to cook only food in the kitchen again.

Girls' Hats Go Useful, Finally

SPRING styles in women's headgear went utilitarian this year in this case anyway, much to the satisfaction of critical males. Took a war to do it, however—this headdress and smart leather shoulder-bag comprise a portable, one-man aircraft detector! The headpiece includes earphones and a "parabolic concentrator of sound waves" connected to an amplifier in the case.

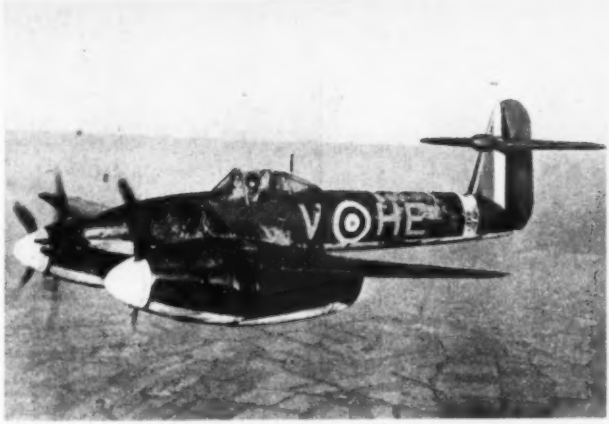


U.S.' New Welded Tank Answers MI Criticisms

THE revolving turret on the army's new medium tank, right, enabling it to fire in any direction without turning around, answers the criticism of the old M-3, left, by Major Wheeler-Nicholson in April MECHANIX ILLUSTRATED. High location of the turret enables the new tank to fire over rises in the ground with less exposure of its bulk. Its rivetless, cast-and-welded hull means speedy production.

Lethal Whirlwind Has A Nose Full Of Cannon

ARMED with four 20 mm. cannons mounted in its nose, the Westland "Whirlwind" is among the RAF's deadliest fighter planes. A distinctive feature is the location of the tail planes well above the line of the fuselage near the top of the tail fins. Two 850 h.p. Rolls-Royce engines power this single-seater monoplane, with a 45-ft. span, 32 ft. 3 in. length, and 10 ft. 6 in. height.

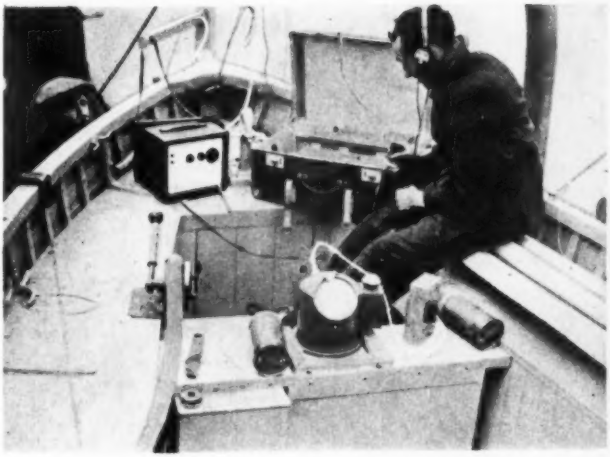


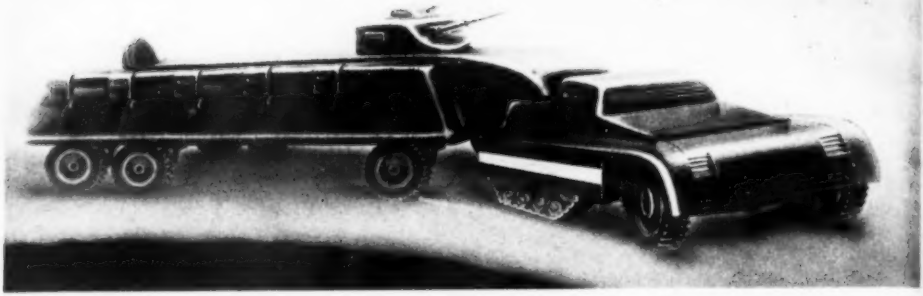
Canadians Carry The War In These Fords

CARRY a squadron of soldiers, captain? Or some ammunition, food, or small arms? The universal carrier's at your service! That's what they say in Canada, where this four-ton, highly maneuverable vehicle is used for all purposes. Armed and armored, equipped with two-way radio, it has a standard truck transmission and axles, will go 45 miles an hour with its 90 h.p. motor. Tracks are driven by sprocket wheels.

Everything But A Sink For Merchant Seamen

BRITISH seamen are given additional life-saving devices as fast as found practical. Here's a standard lifeboat fitted with automatic radio. Canister contains smoke-flares. Fireproof hoods for tanker crews, anti-exposure suits fitted with warning lights to attract rescuers, vitamin rations, and fire-fighting apparatus are among recent additions which every ocean ship is to have.

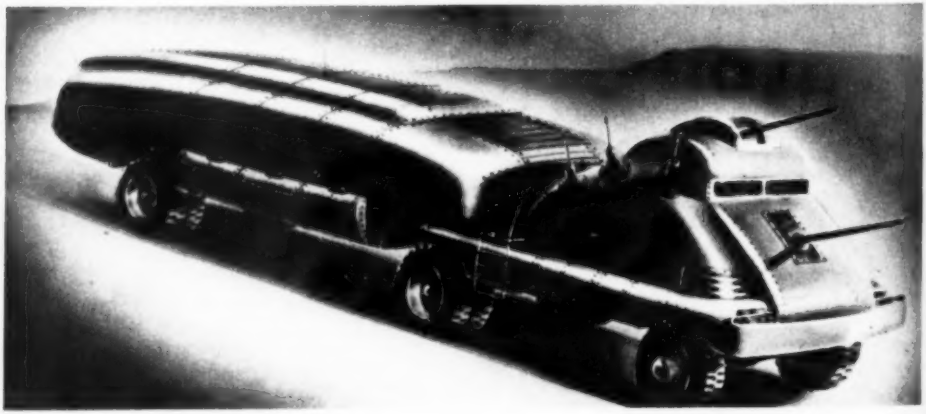




Plane-Line Styles For War Wagons?

WITH all war vehicles using speed as a weapon in advancing a front, industrial designer George Walker of Detroit proposes streamlining them to overcome retarding wind resistance. Here are three of his designs adapting to machines which wage war on the ground, the advantages of streamlining so highly developed in fighting planes.

Thirty men, or ammunition, can be transported in the troop-carrying trailer shown at top here. It's towed by a unit based on the principle of the "half-track," and armed with a large and a small cannon and an anti-aircraft gun. In the center is a six-wheeled tank buggy—a weightier, more heavily armed brother to the light tank. These two vehicles have drivers at front and rear. Below is an ammunition-carrier bristling with 75 mm. cannon and six smaller guns mounted on the motor-driven forward section.



CRAFTS AND HOBBIES

PHOTOGRAPHY
MODELS • RADIO
THE WORKSHOP
HOW-TO-BUILD

LEAF PRINTING, OUTDOORS

by Roy Lester

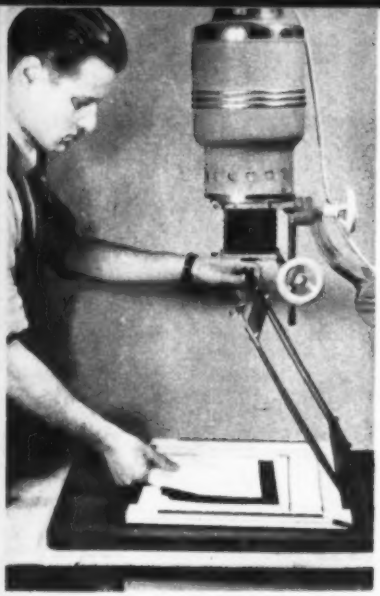
Above: Placing the P.O.P. paper over the leaf in the printing frame. *Above and right:* Typical leaf specimens printed by method described in the text. *Right:* The P.O.P. prints are fixed later, at home.

AMATEUR photographers who are interested in botany and wish to bring home photographic records of various leaves and other flat forms of plant life can do so with the aid of P.O.P. proof paper. This is a photographic printing paper that slowly darkens to a deep sepia tone when left exposed to bright blue daylight, sunlight, or a bright carbon arc.

The leaves or other flat specimens are placed in contact with the paper in an ordinary contact printing frame; they are then exposed to sunlight until the exposed areas of the paper darken to a deep tone. The specimen is discarded and the paper print placed in a dark envelope to prevent further darkening, and brought back to the house for fixing.

The prints should be made several shades darker than desired to allow for the bleaching action of the fixing bath. Average time is 3 to 4 minutes in sunlight; 6 to 8 in daylight. This arrangements permits one to make any

[*Continued on page* 162]

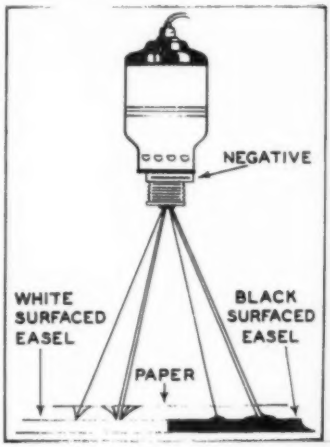


Above: When using a white surfaced easel, it is good practice to place a sheet of black paper under the enlarging paper when making the exposure. This makes for more faithful rendition of the negative gradations.

The Black Easel For Print Brilliance

by Morris Germain, A.R.P.S.

Illustrations by the Author



Right: This is a simplified diagram of the mechanical effects of enlarging on a white, as compared to a black surface-painted easel. It represents a single sheet of paper being printed on an easel that is half white and half black. The single line projected onto each half of the easel represents rays passing through the denser portions or highlight areas of the negative; the double lines represent the greater quantity of light passing through the more transparent shadow areas. Note that the black half of the easel absorbs any light passing through the paper, whereas the white surface reflects light back through the paper—the quantity of reflection being greater in the shadows.

IF YOU wish to capture all the detail and brilliance of your negatives in your enlargements, you must understand how the paper holder or easel functions under various conditions.

When an image is projected onto photographic paper, some of the image-forming light rays will penetrate the paper. Just how much penetration takes place depends upon: the thickness of the paper, the density of the negative, the power of the enlarger bulb, the exposure, the contrast grade of the paper, the size of the enlargement, and the type of enlarger (condenser or diffused type).

The thinner the paper the more the projected image will penetrate beyond the emulsion surface. Penetration is also greater when the negative is thinner; the enlarger bulb, brighter; the exposure, longer; the distance between the lens and paper, shorter, and the paper grade contrastier. Moreover, the condenser type of enlarger is more penetrating than the diffuser type.

Now suppose that in a given case, all factors total up to produce an appreciable amount of penetration. More specifically, let us suppose that we are using one of the popular brands of condenser type of enlargers, with an f/4.5 or f/6.3 lens. The negative is on the thin side—sharp, brilliant, with clear and fairly transparent shadows—the type that would require No. 3 or

[*Continued on page* 152]

Right: Effect of interposing a piece of white paper with black type between enlarging paper and a black enlarging easel. Light passing through enlarging paper is reflected by the white paper as evidenced by a darkening of areas under which white paper lies. Black letters absorb light passing through the enlarging paper as does the black easel, permitting corresponding areas of the print to retain their normal tone—whether latter is light or dark.

PHOTO CONTEST

FIRST PRIZE ($10.00): "Do Tell—" by Hillard Langlie, c/o Advertisers' Service, Inc., 229 E. Wisconsin Ave., Milwaukee, Wis. Taken with a Recomar 33 on Panatomic X, in Edwal 20 developer; 1/200 sec. synchroflash exposure with 16A photoflash on an extension and a Sunflector convex mirror opposite to fill in shadows. Steam from cup is a burning cigarette. SECOND PRIZE ($5.00): "Temptation" by J. J. Gerard, 1632 No. Federal Ave., Mason City, Iowa. Taken with Dollina camera on Panatomic X film; f/4.5 at 1/100 sec. THIRD PRIZE ($4.00): "Look Pretty, Please" by Jack Garber, 308 East 5th Street, Brooklyn, N. Y. FOURTH PRIZE ($3.00): "Quiet" by G. F. Mayes, 33 Bertrand Street, Ottawa, Ontario, Can. Taken on Super XX film in D-76; f/6.3 at 1/50 sec. by photoflood.

Submit prints for this monthly contest, unmounted—no larger than 8x10 inches. Print your full NAME and ADDRESS on the back of each print and wrap securely with cardboard or corrugated stiffeners. With each print, list your camera, film, lens opening and shutter speed, illumination, and developer. If you want unused prints returned be sure to enclose sufficient return postage. (Published prints can not be returned.) Address: Photography Editor, MECHANIX ILLUSTRATED, 1501 Broadway, New York, N. Y.

1st PRIZE

3rd PRIZE

2nd PRIZE

4th PRIZE

VEST FILTER

by Gustav Gerlach

Above: These are the various materials required for the conversion of the trout fly case into a vest pocket case for filters and auxiliary lenses.

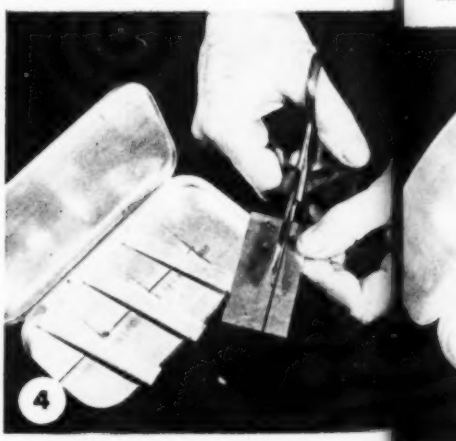
CARRYING filters and auxiliary lenses for your camera becomes a nuisance when you have to hunt through your pockets or carry-all bag to find the one you need—in a hurry! The simple case described here will enable you to carry all accessories of that kind, neatly in your vest pocket.

In most sporting goods stores, you can still purchase a fisherman's aluminum trout fly case. The one illustrated cost just twenty-seven cents; it is roughly 6¼x3¼x½ inches and comes as shown in illustration No. 1.

You can, with a few simple tools, convert the trout fly case into a handy filter carrying case in about an hour and a half. All you need is a pair of scissors, a jack-knife, a ruler, some liquid solder, and mucilage. You will also need a piece of felt about 8 inches square to pad the compartments. All required materials are shown in Illustration No. 1.

First, carefully remove the fly spacer from the bottom of the case,

Above: Removing the two rivets that hold the fly spacer in place. *Below:* Space occupied by each lens and filter is pencilled on the case.



Below: The spacer from the bottom of the case is first cut up into five strips of equal length.

POCKET CASE

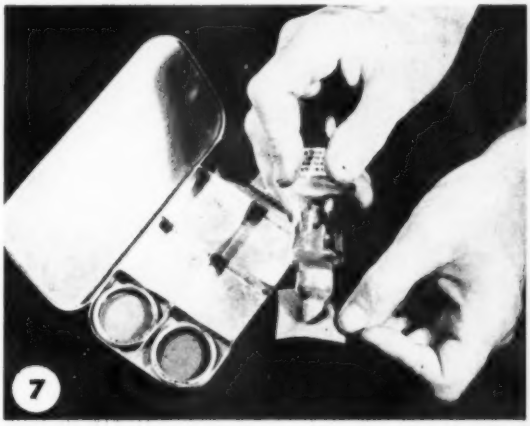
using the jack-knife to cut away the two rivets that hold the spacer in place (Illustration No. 2). After deciding as to the number of compartments you will need, place the various lenses in the case and mark off the spaces with a pencil (Illustration No. 3).

Using a pair of scissors, cut the aluminum spacer that was in the bottom of the case into five strips (Illustration No. 4). The width of the strips should be equal to the depth of the case measured from its bottom to its top inside edge. Then, cut three of the strips so that they are equal in length to the short dimension of the case. Cut the two remaining strips so they fit snugly in between the strips running across the width of the case.

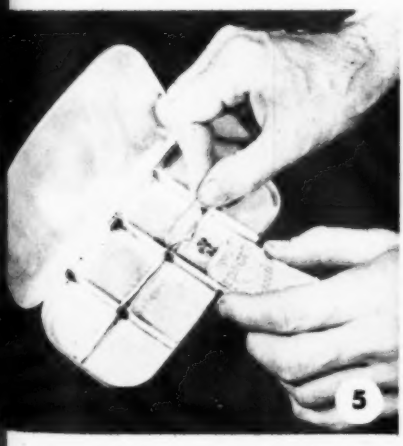
Now, proceed to put a liberal coating of liquid solder directly over the pencil lines marked in the bottom of the case. Then put the strips you had previously cut to size in position over the pencil lines (Illustration No. 5). After the strips are all in place, put

[*Continued on page* 174]

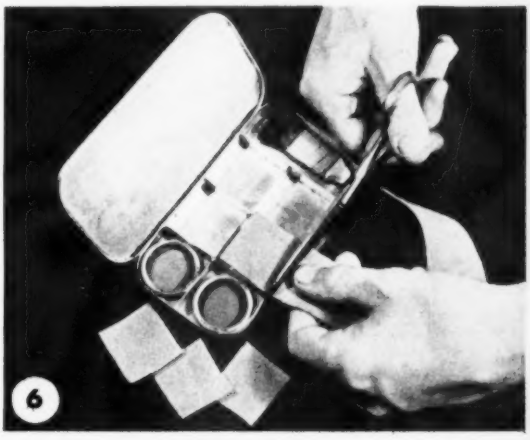
Above: The completed case fitted with the designer's accessory lenses for the Rolleiflex, including closeup and correction lenses and filters.



Below: Square pieces of felt are cut out the exact size of each compartment. *Above:* Each pad of felt is secured in place with mucilage.



Below: Shorter strips from the metal spacer are soldered to case between three of the compartments.



"Trick" Lighting With Hidden Flash Lamps

by Louis Hochman

FIG. 1 (above): The effect of blazing logs in the fireplace has been simulated by flashing a midget bulb among the logs on the same open flash circuit used to illuminate the foreground figures. *FIG. 2 (below):* The "match" struck by the man is actually a midget bulb wrapped in paper and hooked up with the two flash lamps which exposed the foreground figures.

FIG. 3 (right): A Press 25 midget flash lamp placed in the bridge lamp (with the aid of a reducing socket) illuminates the painting and the artist's palette, yet without blocking up detail in the shade of the bridge lamp in which it is set.

THE availability, today, of midget flash lamps (the Press 25 Superflash and the SM and Nos. 5 and 6 Mazdas) goes a long way toward solving many of the special lighting effects that imaginative photographers attempt to create.

These bayonet base lamps are so small that they may be concealed easily in any portion of the composition where a light source logically belongs. They make possible many intricate lighting effects, which would be extremely difficult if not impossible to accomplish with the larger bulbs. Moreover, when used *in conjunction* with larger bulbs, they act as accent lights, building up highlights and improving the depth and modeling of the picture.

Figure 2 offers a typical instance of how a midget flash lamp can be substituted effectively for a light source. Here the light was supposed to be coming from a lit match in the model's hand. To get the effect with a real match would have meant a "time" exposure with the lens wide open. This would require sacrifice of depth of field not to mention the difficulties imposed on the models.

Instead of a lit match, therefore, the subject held a midget, Press 25 flash bulb in his left hand, shading it from the camera with his right hand. The desired effect was instantaneously obtained. With the bulb held so close to the subjects, it was necessary to cut down its brilliance in order to prevent the highlights from burning up, and this was

FIG. 4 (right): A pair of synchronized midget flash lamps sufficed for the entire subject—one, inside the furnace and the other outside the furnace on the model's left hand side.

accomplished by wrapping the bulb in a sheet of white writing paper. This also afforded extra protection against the possibility of the bulb shattering, which may happen despite the safety jacketing on the bulbs.

When holding these bulbs in your hand for a picture, never allow the glass part to rest against your skin. The heat created by ignition of the bulb can inflict serious burns, even though it is wrapped in paper. Play safe and keep the bulb at least half an inch away from your skin.

Additional illumination in Figure 2 was supplied by two other bulbs, a No. 0 and a No. 2, outside of the picture area. All three bulbs were hooked up to one battery and fired simultaneously by the open flash method.

In Figure 1, a midget bulb was set up in the fireplace to give the effect of a burning fire and the girl's extended leg served to shade it from the camera. A larger bulb here would have given too much light, burning up all detail in the fireplace and causing undesirable halation fuzz around its edges. In this case, the small bulb was used without any covering, and it was hooked up to two other bulbs, a No. 0 and a No. 2, for the outside illumination.

The furnace room scene, Figure 4, was managed with two midget bulbs, one placed in the furnace and the other outside toward the rear of the model. To prevent the heat of the fire from firing the bulb prematurely, the furnace was grated down and several shovel-fulls of coal were heaped on the fire. The midget bulb was then placed on the ledge inside the furnace door where it produced the desired effect.

The "Midnight Marauder" in Figure 5 was highlighted with a midget bulb, properly wrapped in white paper and placed in the refrigerator. A No. 2 bulb, outside the picture area, placed high and pointed toward the ceiling gave sufficient diffused illumination for the surroundings.

Whenever you want a soft, over-all light on your subject as in the foregoing case, it is a good idea to point the bulb up at the ceiling. Although cutting down its intensity, this produces an abundance of soft, diffused light, free from the harsh shadows that result from direct illumination.

In Figure 3, a paper-wrapped Press 25 bulb, placed in the bridge lamp, served to

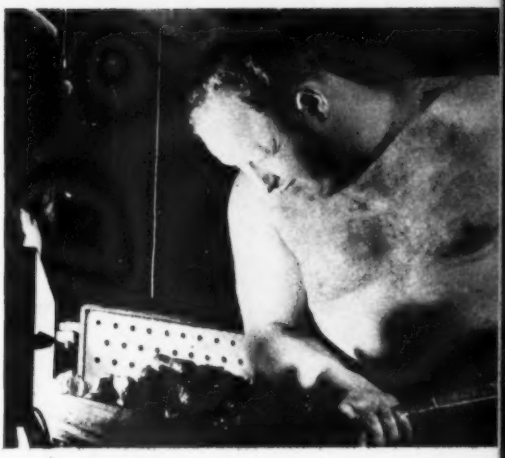


FIG. 5 (above): In addition to the "effect" light placed within the refrigerator, a No. 2 flash lamp was placed outside the field and flashed in the direction of the ceiling.

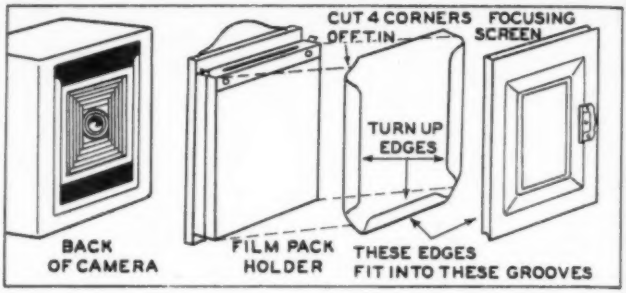
highlight the artist's palette and painting, without even burning up the detail in the lamp shade itself. A No. 0 and No. 2 bulb again sufficed for the outside illumination.

To get the strong highlight on the sculptor's face in Figure 6, a midget bulb was set up

[*Continued on page* 170]

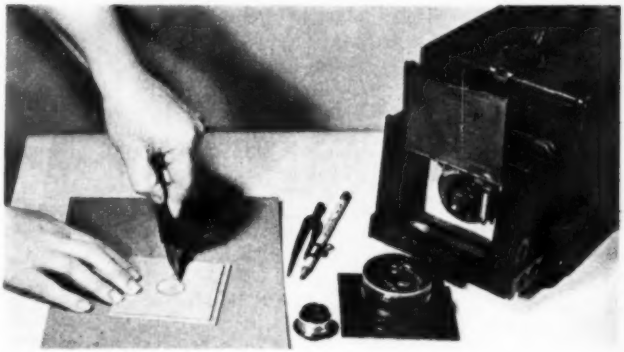
FIG. 6 (right): The highlighting on the sculptor's left hand and face was achieved with a midget bulb just behind the bust.

Camera Kinks



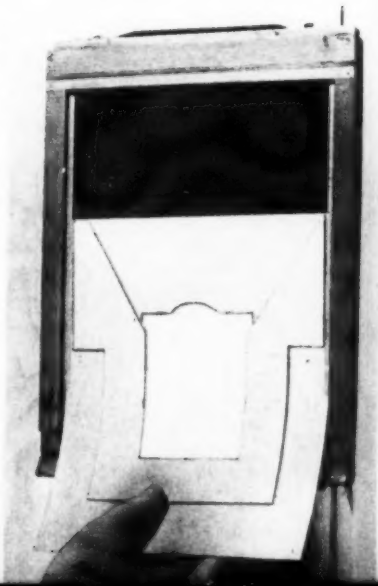
FOCUSING SCREEN BRACKET. To prevent the breakage and/or misplacement of the ground glass focusing screen of the conventional plate back type of camera, the simple bracket shown above and at the left has been designed. A piece of scrap tin was cut to the approximate size of the film pack adapter supplied with the camera; its two long edges and its bottom edge were then turned over to form tracks accommodating the camera's focusing screen. The bracket was soldered to the four corners of the film pack adapter back and painted black to harmonize with the camera color. After use, the screen is immediately slipped into its bracket. *Andrew Vana.*

Right: Extra lenses for interchangeable lens cameras can be mounted in lens boards made of 1/16 to 3/16-inch cardboard. Glue two pieces together, one the size of regular lens board and the other, slightly smaller, conforming to the inner baffle surface. Cut hole in exact center of board a bit smaller than lens barrel so lens screws in tightly. Paint the board black. *Louis Hochman.*

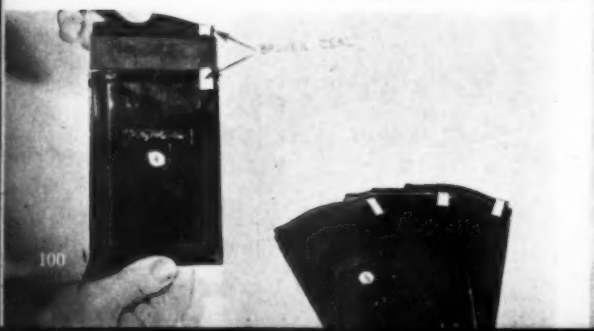


Below: To forestall like leakage in an old box camera, slip a rubber band cut from an old inner tube around the crack where the front and back fit. Tension holds parts together. *Paul Hadley.*

Right: Adapt 8x10 cut film holder to take 3¼x4¼ film by cementing an 8x10 cardboard, with 3⅜x4⅜ hole in its center, to a U-shaped piece of cardboard overlapping the hole in larger piece by 3/16 inch on three sides. *A. J. Lockrey.*



Below: Prevent double exposures on cut film by sealing the top of the slide to the holder in loading latter—using gummed paper. The seal is broken when pulling out slide for exposure. *L. Hochman.*



ARCHERY EQUIPMENT

HOW TO MAKE IT

PART II

Last month we completed the bow almost up to the stringing. We now add handle, bowstring, and make arrows and target.

by Bertram Brownold

THAT part of the handle that the archer grips should be tightly wrapped with fishline. This job can be done as soon as the tillering is finished. Use a wire loop to draw the end of the fishline under the wrapping. See *Photo 5*. After the wrapping is on, saturate the fishline with shellac. When the shellac is dry it will make an excellent grip and will exclude moisture and prevent rotting.

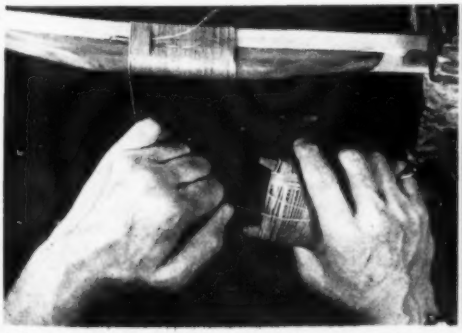
Back the nocked ends of the bow with tough fiber of the kind used to make suit cases and sample cases. Glue the fiber in place under pressure and when dry trim and smooth it with a file and sandpaper. The fiber strengthens the ends and guards against wear and splintering.

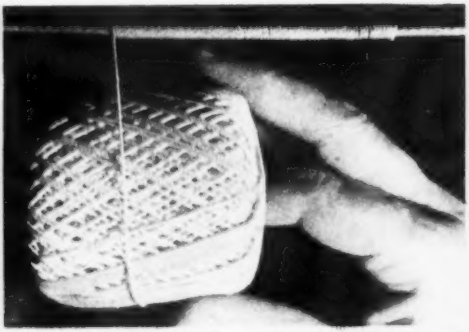
Round both ends of the bow with a file and finish with sandpaper.

Also round off slightly the edges of the belly side of the bow.

Sand the bow all over with fine paper, rub it down well with a clean cloth to remove all dust, and shellac the whole bow. When dry, sand and shellac once more. Finally, sand off the second coat of shellac and apply a light coat of a good grade of varnish, slightly thinned out with turpentine. When dry, the bow is ready to be "braced." To brace a bow means to bend it and affix the bowstring.

Photo 5A: Rubbing the waxed bowstring vigorously with brown wrapping paper. This heats the wax and fuses the twisted strands together. Latter have been twisted by slowly spinning the stone tied to their lower ends.





Left, Photo 5: How the fishline is wrapped around the handle. Last turn of the line is run through the loop of the wire and pulled under, finishing off the job neatly. *Right, Photo 6:* Completed bowstring is served (wrapped) at the center with fishline. This strengthens the string at the point of greatest wear. Other points to be served are at the two loops.

Photo 7: Bracing the bow. The lower tip is placed in the rim of the shoe sole, while one hand holds the handle, the other being placed near the upper end of the bow. Bracing a bow in this manner applies pressure at mid-point and the two ends. After bracing, the distance from mid-point of the bowstring to the handle should measure six or seven inches.

The Bowstring

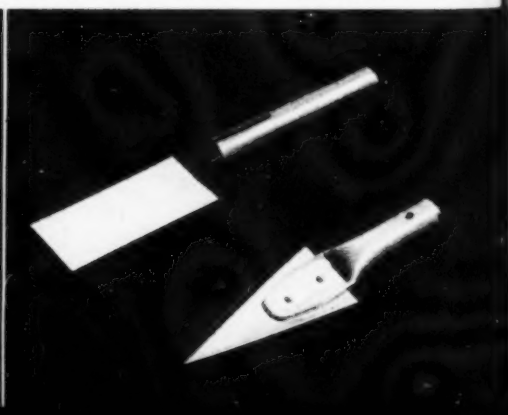
Linen shoemaker's thread is excellent material for making bowstrings because it is strong, will not stretch, is inexpensive and is easily obtainable. The correct weight is a thread which, when six lengths of it are twisted together, will produce a bowstring somewhat less than ⅛" thick.

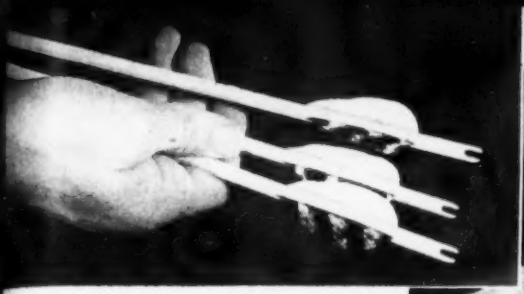
Cut six pieces of the thread, each about a foot and a half longer than the bow. Wax each piece thoroughly with beeswax, and then wax the whole bowstring again after the six threads have been twisted together. A good way to do this work is to attach the threads to the limb of a tree or any other convenient place of sufficient height. The twisting can be accomplished easily and evenly by attaching a weight to the lower end of the bowstring and spinning it.

After the waxing and twisting have been done, rub the bowstring vigorously with a piece of stout wrapping paper. This heats the wax and fuses the six strands together. It is suggested that a glove be worn for this job. See *Photo 5A.*

Next, splice an eye or loop at each end of the bowstring, so that the length from loop to loop will be some three or four inches shorter than the straight line distance between the

Photo 8, below left, shows a target tip, the making of which is described in the article. *Photo 9, at the right,* shows how a hunting tip is made. The split tube is flattened to form a holder for the tip, whose sides have been sharpened with a file.





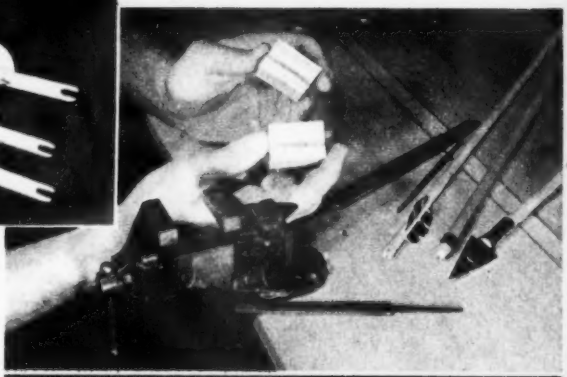


Photo 10, above, shows the nocks in the arrow for engaging the bowstring. The feather that is set at right angles to the nock should have a different color than the other two, to enable the archer to see at a glance how to place the arrow on the string. Photo 11, at right, shows grooved wooden blocks which face jaws of vise when working on arrows.

nocks. The last step in making the bowstring is to serve it (that is, wrap it tightly) with fine fishline in three places. The three places are the two loops and the center. These are the three points of greatest wear. When serving the loop, start at a point about three inches down the string; and when serving the center, cover about eight inches. *Photo 6* shows the bowstring being served at the center.

Bracing The Bow

Slip one of the loops of the bowstring over one end of the bow and into the nocks. Then bend the bow and slip the other loop into the nocks at the other end. This may prove harder to do than it sounds, at least the first time that it is attempted; but with practice it becomes easy. The correct way to do it is to place the lower tip of the bow on the projecting rim of the sole of one's shoe. This prevents the tip of the bow from sinking into the ground and becoming soiled. The right hand (if the archer is right-handed) then grasps the handle of the bow firmly while the left hand, placed near the upper end of the bow, exerts the pressure which bends the bow. The fingers of the left hand slide the loop into the nocks. Bracing a bow in this manner applies pressure at the three points that are meant to take it—namely, the mid-point and the two ends.

After the bow is braced, a perpendicular line from the mid-point of the taut bowstring to the handle of the bent bow should measure some six or seven inches. *Photo 7* shows a bow being braced.

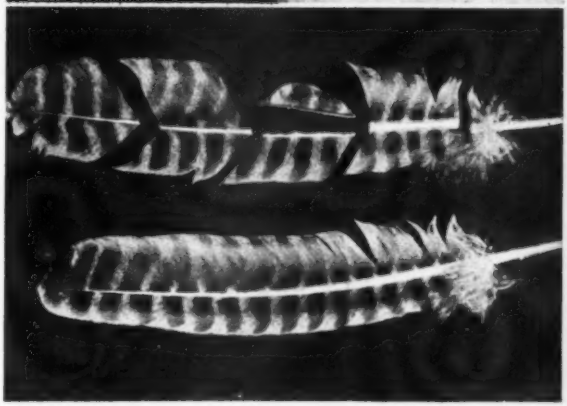


Photo 12, above, shows how turkey feathers are cut to make arrow feathers. The upper feather has been cut into 2¼" sections, measuring on the quill. One of the sections has been split and half of it shaped on the template.

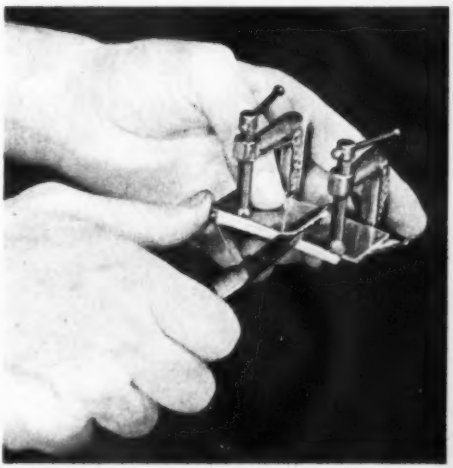
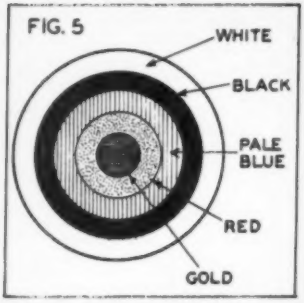


Photo 13, above, shows the feather held in an improvised vise made of two pieces of sheet metal and two C-clamps. The quill of the feather is being removed with a sharp knife until only a thin sliver of it remains.



Above: The target. The width of the concentric rings is one-tenth of the diameter of the target. The target may be any size. *Photo 13*, at the right, shows a box target being filled with straw.

Making Arrows

There is a special pleasure to be had from the delicate art of arrow making, for a well made arrow is as much a thing of beauty as a well made bow.

Hardwood dowell sticks offer the best and most easily obtained material for arrows.

Use sticks that are $\frac{5}{16}$" thick for target arrows, and $\frac{3}{8}$" thick for hunting arrows. As to the length, 26" to 28" are the correct lengths, the longer for hunting and the shorter for target work.

Be sure that each length is straight. This is important. A bent stick results in an arrow whose flight is erratic. Sight along the sticks to be sure that they are straight and roll them on a flat surface to disclose irregularities. It will pay to discard all that are not straight.

Sand each stick with fine paper.

Points suitable for target practice can be made by driving a light nail into one end of the stick in the direction of the grain, clip off the head of the nail and file the end of the stick and the nail as well to a sharp symmetrical point. The nail need protrude only about $\frac{3}{32}$". Then force a piece of light brass

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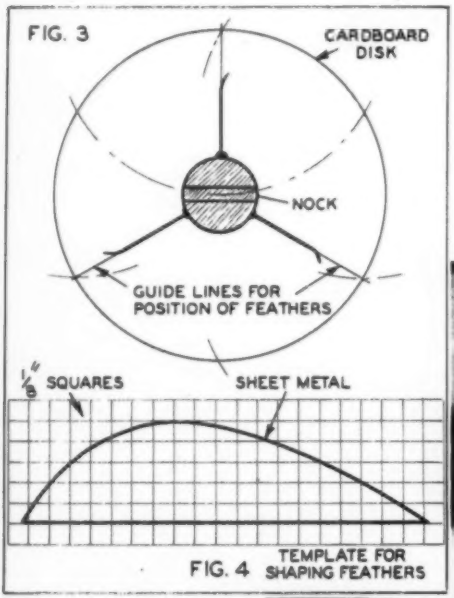
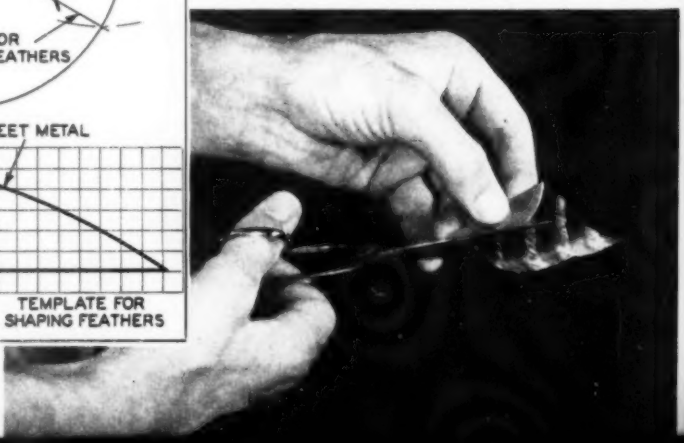


FIG. 4 TEMPLATE FOR SHAPING FEATHERS

At the left are the diagrams for the feather guide and the feather template. *Photo 14, below*, shows a feather being shaped on the sheet-metal template with a pair of scissors.



2 TUBE BABY BROADCASTER

by C. G. Crose

THE construction of "wireless" oscillators has been described before. Most of them have been of the phono-oscillator type, designed to be used with electrical phono pickups only.

The "broadcast station" oscillator we are about to describe is, we believe, about the simplest of any of the circuits previously described, but provides for the use of either a microphone or phonograph pickup. Only two tubes and a handful of parts are required to build this unit. "Baby Broadcaster" is an appropriate title because the chassis measures only 5½" by 4¼" by 1½".

This oscillator is *literally* a broadcast station. It "broadcasts" a modulated radio wave from its antenna to your standard living room receiver. It will easily cover a distance of about 25 feet.

First, here are a few words about the theory of operation of this oscillator. The 25Z5 tube serves as a rectifier of the AC voltage applied to the oscillator. The resultant DC voltage is filtered by the two 8 mfd electrolytic condensers and the 4,000 ohm resistor connected to the cathode of the 25Z5 tube.

As you can see, no transformers are used—this unit employing the AC-DC principle of operation. Outside of rectifying the AC

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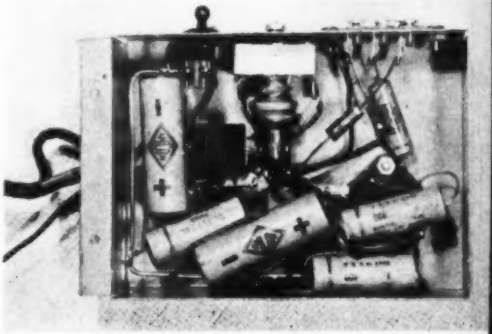
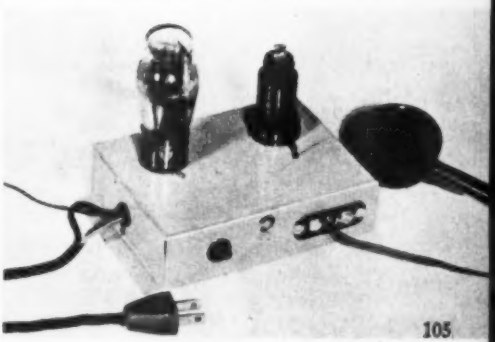


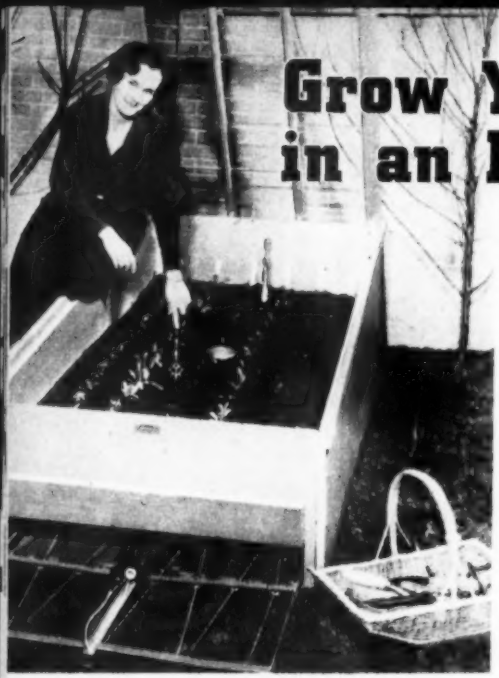
Effective over distances up to 25 feet, this tiny broadcasting station can also be used for playing records through your radio. Photos above and below show bottom and top views.



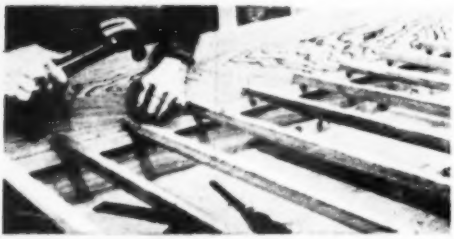
Grow Your Seedlings in an Electric Hotbed

Home craftsmen will find it easy and inexpensive to build and operate an electric hotbed. With this latest mechanical marvel, you will have fewer losses and a more uniform, healthy development of flower and vegetable plants.

by Earl W. Gage



Healthy, vigorous plants can be cultivated in the electric hotbed. This one has the complete heating unit which slides into the bottom of the frame, like a bureau drawer.



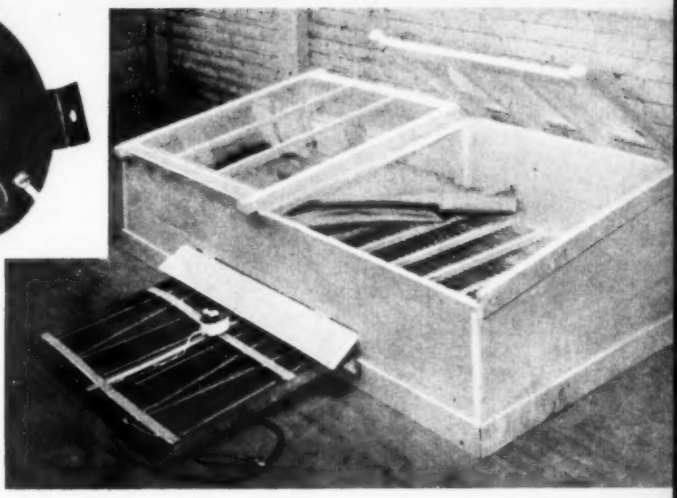
THE old-fashioned hotbed, which depended entirely on natural heat, is a thing of the past with modern home gardeners. Artificially electrically-heated beds, controlled by thermostat, at any desired temperature, between 50 and 100 degrees Fahr., mature plants faster and more sturdily. Each hotbed section is warmed to meet the special needs of the type of plants seeded, irrespective of outside temperature. There is no loss due to insufficient heat or to root singeing; each plant receives the same warming stimulation.

There are two types of electric hotbeds in general use. One uses the ready-assembled heating unit, which slides into a special compartment underneath the hotbed. The other is an electrically-heated cable which is placed in the soil, in parallel lines. Both are heat controlled by a thermostat.

To build either type of hotbed is easy. Rough cypress lumber is the best for the case. Any size close-fitting or matched 1-inch boards may be used. These should fit snugly together to prevent air circulation which would result in loss of heat.

To build the compartment type 6'x12' standard hotbed, the following bill of material is needed: for the outside frame—4 3'x6' hotbed sash; 1 front 1"x12"x12'; 1 back 1"x18"x12'; 2 sides 1"x12"x6'; 1 cut diagonal for sides 1"x6"x6'; 3 sash supports 2"x4"x6'; for the inside frame—1 back 1"x17¾"x11' 8"; 1 front 1"x12"x11' 8"; 2 sides 1"x12"x5' 8"; 1 cut on diagonal 1"x6"x5' 8"; 5 spacers 1"x12"x11"; 9 spacers 1"x12"x17¾"; top base—4 doors 1"x4"x38"; 5 supports 2"x4"x6'; 6 floor boards 1"x12"x12'; 1 back board of top base 1"x4"x12' bottom base—5 supports 2"x2"x6'; 6 floor boards 1"x12"x12'. 8 hinges;

Left: Hotbed partly assembled, with heating element partly pulled out in bottom. Note layers of screening, burlap and earth, respectively, atop the frame. Above, left: Support for cross members is nailed to sides, providing space for heater 6-in. deep.



Above: The automatic temperature control thermostat for the hotbed. Right: Completed hotbed with sash in place. Electrical supply or mail order houses can provide parts.

4 outlets; 4 hotbed heater units. One heater cares for each 3'x6' section. Wiring and nails as required.

The earthen pit over which the hotbed is placed should be located on the south side of the house or garage, on ground having good drainage. If necessary, you can excavate and fill with gravel or cinders, to insure proper drainage in wet soil. This is tamped down so that it will be sound to hold the hotbed without sinking.

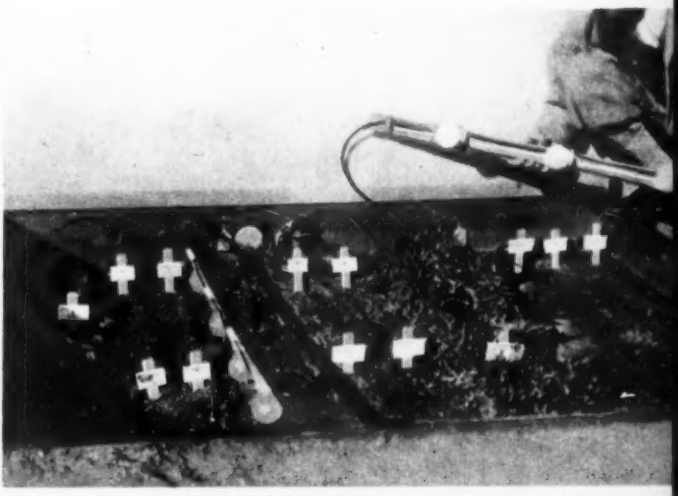
For the four compartment 6'x12' hotbed, using assembled heat unit, a shallow pit is excavated about 6" or 8" deep. This should cover an area 6' 6" wide and 12' 6" long, to allow for straw insulation spread on the outer side of the bed. Fill the pit with cinders and coarse gravel or sand. Make the filling flush with the top of the ground. The platform of the hotbed rests on the cinders and the heater units are placed on top of this, as shown in drawings and pictures.

The top base may be built of loose fitting boards to allow the heat to pass up through the soil. Metal or burlap-covered wire screens may be used, if preferred, to prevent the soil from dropping down on the heater. The outside frame is placed over the inside frame, as shown. Dead air space is obtained by means of small spacers between the two frames, which also help to strengthen the framework.

The outside frame is not fastened to the bottom base. The sash rests on the outside frame. If it be necessary to raise the sash, due to high plants, the outside frame may be raised independently of the inside frame.

The sash (3'x6') is next put into place. This consists of four pieces of the type shown. Fit the sash so all parts are snug against each other, to prevent loss of heat. In northern districts, where it may be extremely cold, and where there is a wide variation in temperature between night and day conditions, it is

[*Continued on page* 127]



Right: Another type of hotbed, utilizing electric light bulbs socketed in strip placed over bed. It is easily assembled, but does not heat the soil as efficiently as the underneath unit.

HINTS FOR THE

Lawnmower Marks For Planting

AN ORDINARY lawnmower serves as an efficient marker when planting creeping grass of the kind popular in hot, dry areas. The lawnmower is turned over as shown, and run over the previously prepared ground. When the first set of parallel lines are made, run others at right angles. Plant at the points of intersection.—*B. N.*

Empty Salt Carton Protects Transplants

TRANSPLANTS may be very satisfactorily protected by the economical means illustrated in the photograph below. Ordinary shaker salt cartons of the type equipped with a spout, are placed over the transplants as shown. The bottom is, of course, first removed from the pasteboard carton. Spout is left open for ventilation.

Holding The Garden Hose

AS THE outside faucet to which the garden hose is attached is usually located in such a position that the hose runs through a flower bed, a wooden "staple" as shown, is advisable to hold it. This will prevent damage to flowers when hose is pulled.—*R. F. Y.*

HOME GARDENER

Mark For Seeds And Flowers

FASTEN a strip marked with color and variety, around the stem of the flower you plan to save for seed. Then, when the flower is picked, slip the dried head, label and all, into a jar as shown. This saves the trouble of labeling the jar separately, and also assures that the label is correct. Screw-cap jars are good.—*B. N.*

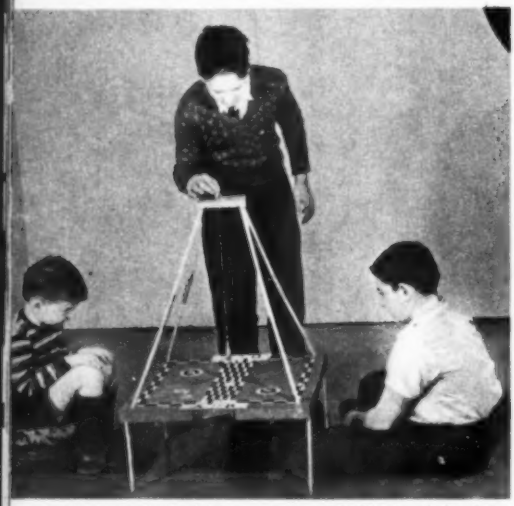
Hairpins In The Ivy

THE graceful curve of an ivy plant which hangs over the sides of its vase, is easy to produce quickly by means of a few hairpins. Push the hairpins into the earth in the pot, with the U-bends over the stems. This holds them down as shown.—*B. N.*

Plants In Egg Shells

EGG shells make excellent pots for starting plants indoors. Fill them with earth as shown, and keep them in a muffin tin for easy handling. When the time comes to transplant them outdoors, it is a simple matter to do it, shell and all.—*B. N.*

play BOMBSIGHT,



Above: The "bomb" is swung around inside the circle of the bombsight and released while in motion. Targets are dummy ships in checkered convoy lanes. *Below:* Details of game.

Guide your ship convoy safely to its destination in the face of enemy air attack! The whole family will enjoy this thrilling game, originated exclusively for MI readers.

by Bertram Brownold

HERE is a brand new game, competitive, exciting, and totally unlike any other game. It is not a game of luck, but requires both a skillful hand as well as the exercise of judgment.

The board on which it is played, as well as the necessary equipment, cannot be purchased at any store as this game was especially designed for MECHANIX ILLUSTRATED. But readers desirous of playing the game should have no trouble making their own equipment, all of which is very simple.

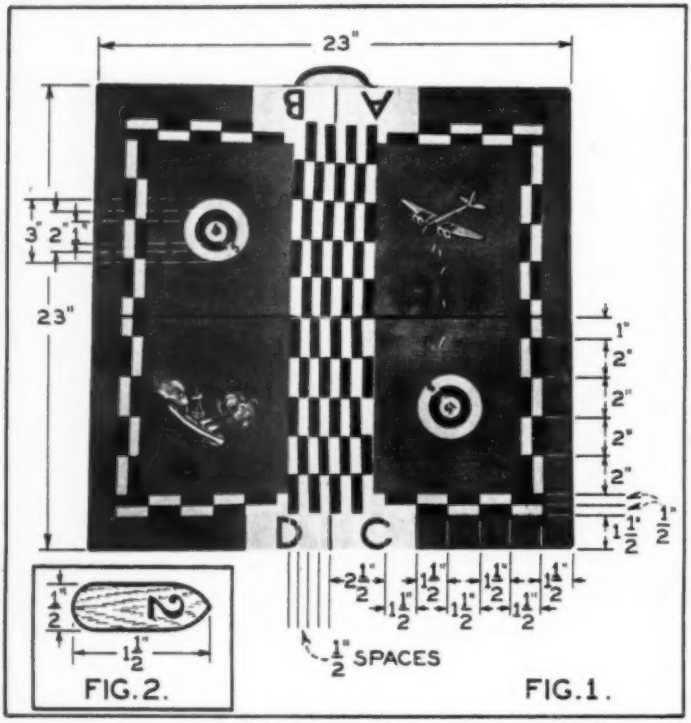


FIG. 1.

FIG. 2.

The board itself is made of two shallow boxes hinged together. It is well to make the sides and ends of each box of hardwood, dovetailed and glued. While this is not absolutely necessary, it is advisable, as sturdy construction will stand up to the hard knocks that youthful players will give it. A simple gluing jig is shown in the photos. It is made of scrap wood, two bolts and nuts, and is fastened to a board or table-top.

The bottoms of the boxes should not be of hardwood, but of soft, and the softer the better, for reasons that will appear. These bottoms can be anything from ¼" to ¾" thick.

When the hinged boxes are open they

exciting new war game

form a square on the outside of which the game markings are painted. When closed, all the equipment is packed inside. Hooks and screw-eyes keep the box closed. Use flat-metal hooks of the type that pivot on a roundhead wood screw, and bend the hooks away from the wood slightly so that they must be sprung into the screw-eyes. This will keep the hooks from dropping out of the eyes and the box from falling open when it is moved about.

The game markings and dimensions are shown in Fig. 1. In painting the game markings use two contrasting colors on a ground of a third. An easy way to accomplish the paint job is to use black and white. Mix some of both together to make gray and paint the whole board with it. When dry, paint in the markings with the remaining black and white.

Another way to mark the board is to use colored paper, cut to the correct sizes, pasted down securely with rubber cement or other suitable adhesive, and varnish over.

While it is not necessary to adhere precisely to the dimensions given here, it is suggested that if any dimension is changed, it will be found advisable to alter all other dimensions in approximately like ratio.

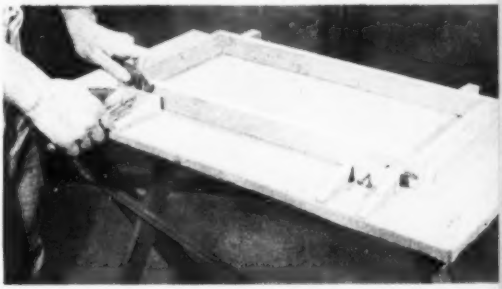
The equipment needed for the game is as follows:

A square of wood 6″x6″x about ¾″ thick, with a circular hole in the center, 2″ in diameter.

Four legs of dowel sticks, each 26″ long and jointed in the middle with a piece of metal tube. The joint permits them to be packed into the box with the rest of the equipment. The upper ends of the legs fit into sockets in the 6″ square while their lower ends rest in sockets in the frame of the game board. Thus when the game is set up ready for play the 6″ square (called the "bombsight") is supported on the four legs about 19″ above the playing surface of the board.

The next piece of equipment is a lead fishing sinker with the lower end drilled to receive a heavy needle. The needle is forced into the hole *eye first*. To the sinker a string is attached, and to the other end of the string

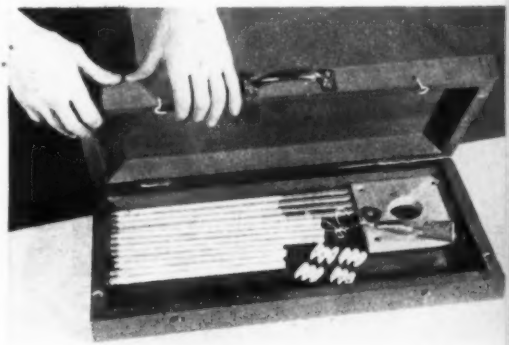
Gluing jig for the boxes are made as shown above. Turning machine screw puts the pressure on the corner joints.



Here's a box set up in the jig while glue dries. Note single dovetail joint. Use waterproof of plastic resin glue.

is tied a ring small enough to slip easily through the hole in the bombsight. The length of the string should be such that when the sinker is lowered through the bombsight the needle will be suspended about an inch above the board when the hand holding the ring rests on the bombsight.

[*Continued on page* 148]



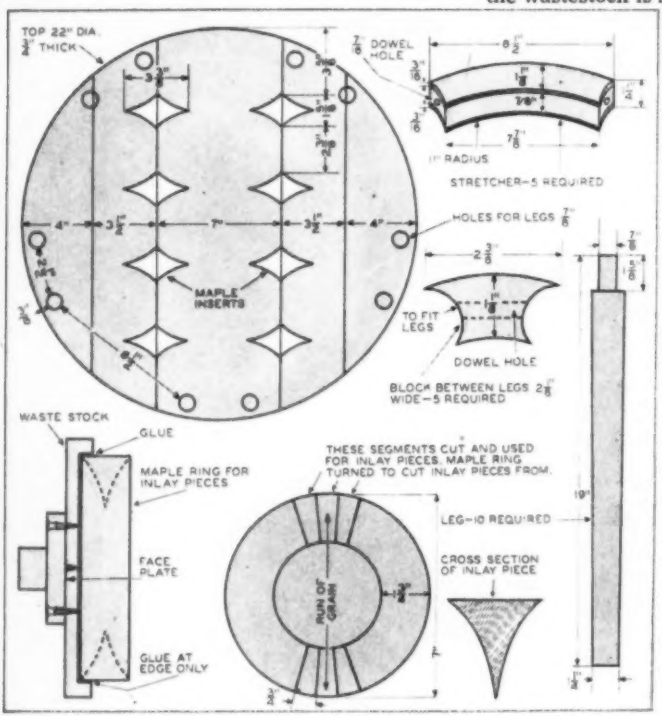
Right: Completed game, with legs, ships, bomb and bombsight packed in the portable box which is also the playing board. Boys in camp will find *Bombsight* a fascinating pastime for leisure moments, and a good developer of the timing instinct.

INLAID COFFEE TABLE

by Benj. Nielsen

THIS coffee or cocktail table is exceptionally beautiful and sturdily built. Construction begins with the walnut top. The pieces to be used for the central part of the table top are glued together with a piece of thick paper between. Wastestock is glued to either side to make a balanced unit for turning in the lathe as shown in photo. Cuts are then made (see drawing), and a cardboard template is used to insure accuracy. Then the wastestock is sawed off and the pieces are taken apart. Two rings are then turned from blocks of maple. Again a cardboard template must be used to insure accuracy. Next the rings are cut into sections as shown in the drawing, for the inlay pieces. These pieces are then glued into the cuts. When dry the boards are carefully jointed and dowelled together. Additional pieces are used to obtain the desired finished diameter of the top. The strengthening rim, which is composed of five pieces, is glued to the underneath edge of the top. Its cross sectional dimensions are similar to the stretchers.

Five pairs of legs are turned to dimensions given, then sanded before removing from the lathe. Tenons are turned on the top end of each leg. Note that these tenons go



When table is thoroughly sanded, apply finish. Only high grade varnish should be used. Sand lightly between coats.

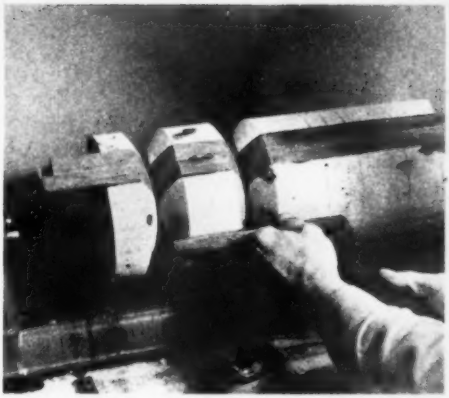
through the top of the table, the rounded end projecting slightly. This is a very strong and novel method of assembly. Each set of legs is dowelled together with a block shaped as shown. Curved stretchers are then dowelled between each pair of legs. These stretchers are built up from three pieces for additional strength. If blocks and stretchers are sanded before assembly the job will be easier.

Care should be exercised to secure an accurate fit between the legs of the table and the blocks between them. The same is true of the stretchers between the sets of legs. Care should be used in the dowelling process to prevent excess glue from squeezing out and hardening on the surface of the wood that is to be finished.

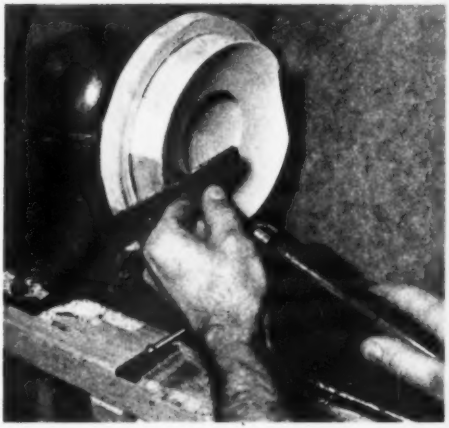
The same is true, of course for all other glued joints throughout the project.

A pleasing effect can be attained if desired, by using a hard wood of lighter color than the top, for the legs. In the case of the woods described, maple may be used for the legs as well as for the inlay work. An attractive contrast is formed when mahogany and maple are employed, although if conservatism is desired, the maple may be limited to the inlay only.

The best grade of liquid-proof varnish should be used in finishing the table.



Turning top boards of table to make notches for the inlays.



This double concave maple rim is sliced grainwise for inlays.

Setting curved blocks between pairs of legs. They're dowelled.

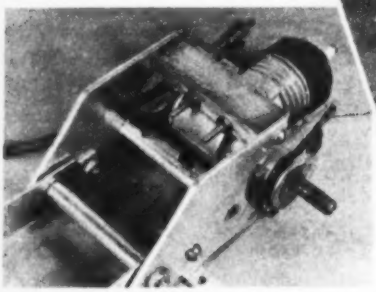
Build "JEEP"

Fast Mini-Racer

by

Frank Caporael

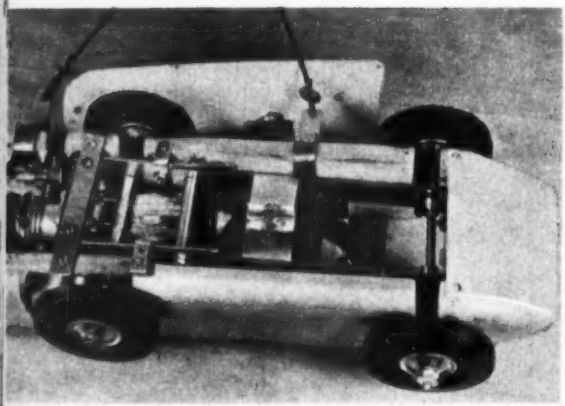
"Jeep" ready to go. Switch with wire extension in back position is off. Note husky bridle.



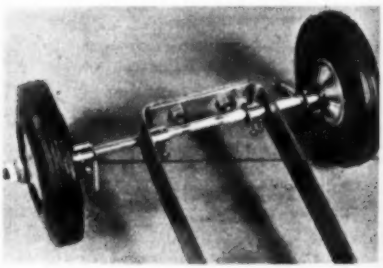
Motor mounting, with cylinder head at front of car. Brass tubing acts as spacer.

DESIGNED to require the least possible amount of metal, this little streamlined midget racer is nevertheless heavy enough to hold the "road" well and attain high speed.

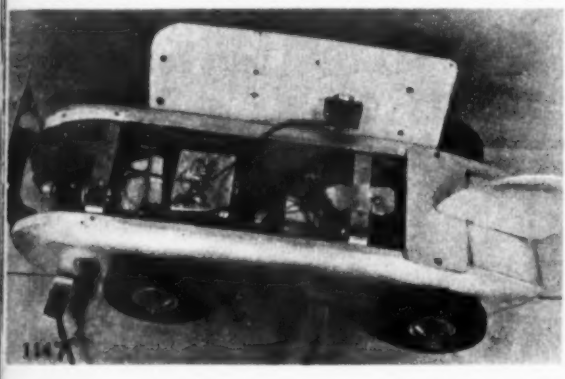
"Jeep" may remind you of Malcolm Campbell's *Bluebird,* and not without reason, for her general appearance was inspired by that famous racing machine. And the resemblance doesn't stop there, for in proportion to her size she is just as fast, or perhaps faster, than Campbell's record holder.

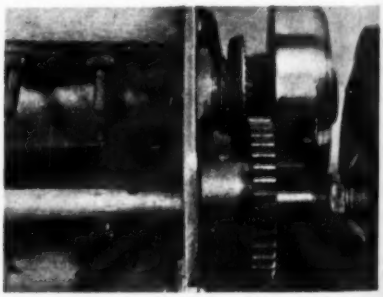


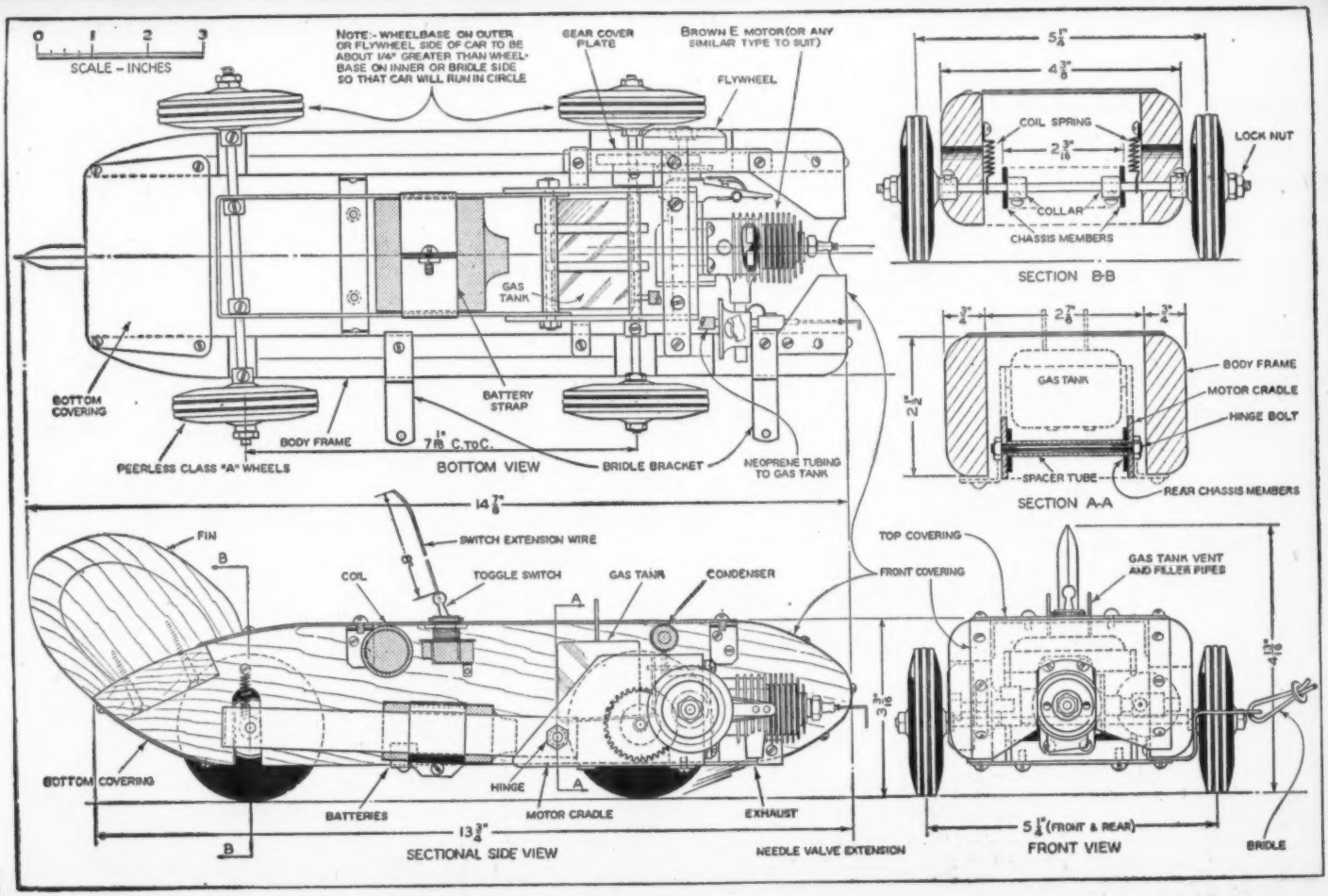
Above: Bottom view shows compact arrangement of car's mechanism. Exhaust outlet points downward. Metal strip covers gears and acts as support. *Below:* Wiring is standard. Follow motor mfg's diagram.

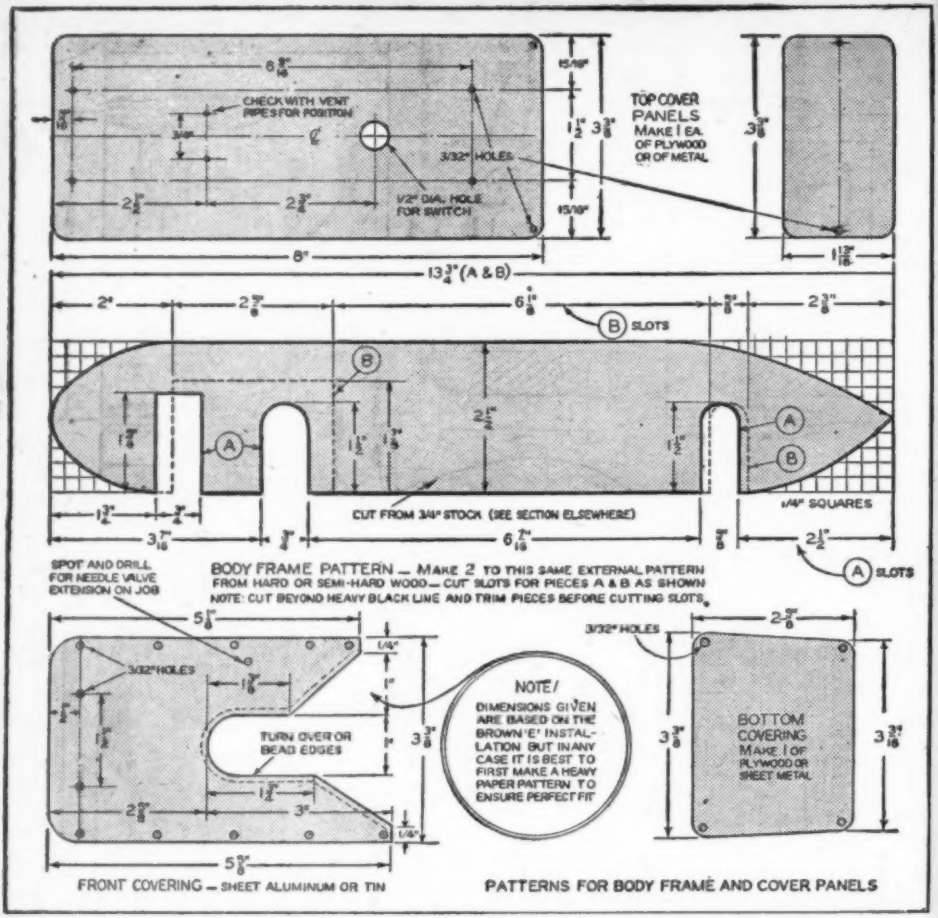


Above: Rear assembly, with collars to keep axle and wheels in place. *Below:* Closeup of gears.






SCALE – INCHES
NOTE:- WHEELBASE ON OUTER OR FLYWHEEL SIDE OF CAR TO BE ABOUT 1/4" GREATER THAN WHEEL-BASE ON INNER OR BRIDLE SIDE SO THAT CAR WILL RUN IN CIRCLE
GEAR COVER PLATE
BROWN E. MOTOR (OR ANY SIMILAR TYPE TO SUIT)
FLYWHEEL
GAS TANK
BOTTOM COVERING
BATTERY STRAP
BODY FRAME
7/8" C. TO C.
PEERLESS CLASS "A" WHEELS
BRIDLE BRACKET
NEOPRENE TUBING TO GAS TANK
BOTTOM VIEW
5 1/4"
4 3/8"
COIL SPRING
2 3/16"
LOCK NUT
COLLAR
CHASSIS MEMBERS
SECTION B-B
3/4"
2 7/8"
3/4"
GAS TANK
BODY FRAME
MOTOR CRADLE
HINGE BOLT
2 1/2"
SPACER TUBE
REAR CHASSIS MEMBERS
SECTION A-A
14 7/8"
FIN
SWITCH EXTENSION WIRE
COIL
TOGGLE SWITCH
GAS TANK
CONDENSER
TOP COVERING
FRONT COVERING
GAS TANK VENT AND FILLER PIPE
BOTTOM COVERING
HINGE
BATTERIES
MOTOR CRADLE
EXHAUST
13 3/4"
NEEDLE VALVE EXTENSION
3 3/16"
4 13/16"
5 1/4" (FRONT & REAR)
BRIDLE
SECTIONAL SIDE VIEW
FRONT VIEW


CHECK WITH VENT PIPES FOR POSITION
3/32" HOLES
1/2" DIA. HOLE FOR SWITCH
TOP COVER PANELS MAKE 1 EA. OF PLYWOOD OR OF METAL
8"
13 3/4" (A & B)
B SLOTS
A SLOTS
CUT FROM 3/4" STOCK (SEE SECTION ELSEWHERE)
1/4" SQUARES
SPOT AND DRILL FOR NEEDLE VALVE EXTENSION ON JOB
BODY FRAME PATTERN — MAKE 2 TO THIS SAME EXTERNAL PATTERN FROM HARD OR SEMI-HARD WOOD — CUT SLOTS FOR PIECES A & B AS SHOWN
NOTE: CUT BEYOND HEAVY BLACK LINE AND TRIM PIECES BEFORE CUTTING SLOTS.
3/32" HOLES
TURN OVER OR BEAD EDGES
NOTE! DIMENSIONS GIVEN ARE BASED ON THE BROWN 'E' INSTALLATION BUT IN ANY CASE IT IS BEST TO FIRST MAKE A HEAVY PAPER PATTERN TO ENSURE PERFECT FIT
BOTTOM COVERING MAKE 1 OF PLYWOOD OR SHEET METAL
FRONT COVERING — SHEET ALUMINUM OR TIN
PATTERNS FOR BODY FRAME AND COVER PANELS

The wooden body frame may be cut from white pine, or any other wood at hand, with the exception of balsa, which is too soft and light. Make patterns actual size on cardboard, following dimensions given above.

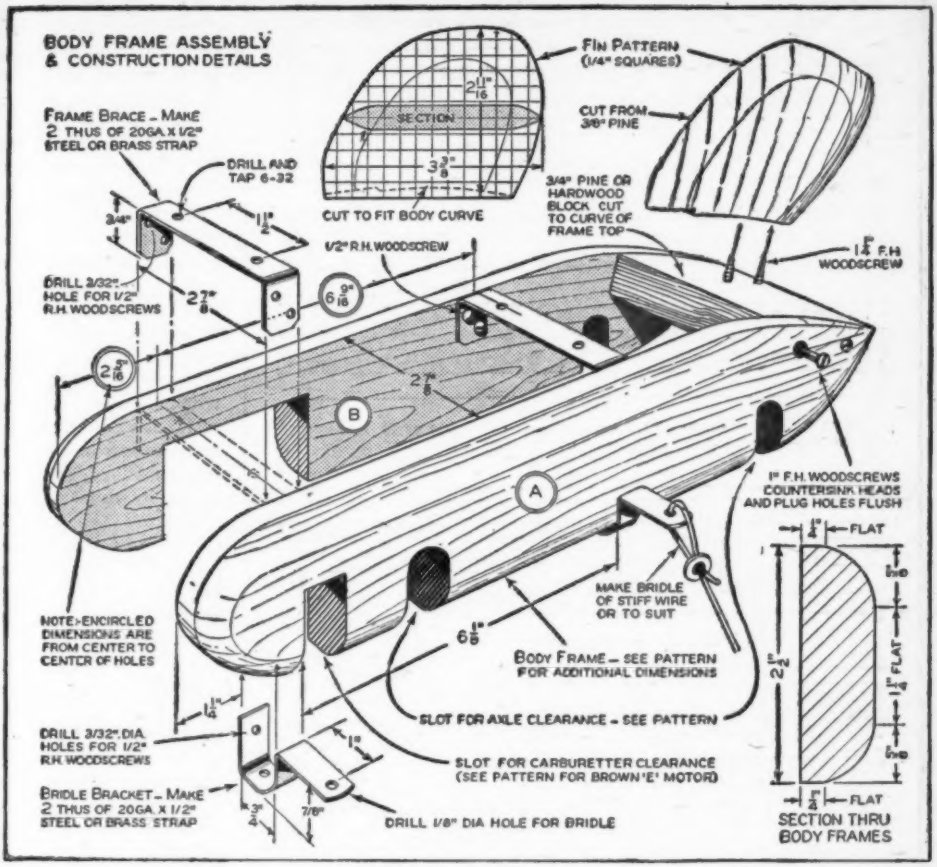
The gas engine is geared directly to the front wheel assembly, with the cylinder head pointing forward and cooled by an uninterrupted air stream.

Construction of the car does not require any special tools, and everything needed can be found in the average household tool box, with the exception of a thread cutting die and tap, obtainable at any five and ten cent store.

The first step in construction is the motor cradle. Since all one-cylinder motors set up a tremendous vibration this must be built as sturdily as possible. The sides of the cradle are made of $\frac{3}{32}$"x2" brass strip. The cross bars that hold the motor are cut from solid stock $\frac{3}{8}$"x$\frac{5}{8}$". The sides are cut to the shape and dimensions shown in the drawing. The half circles into which the motor shaft sets may require a small change in dimensions for various types of motors. The dimension shown however will be suitable for most motors.

To attach the sides to the cross bars, drill the bars and tap with a 6/32 tap. Attach the sides with 6/32 screws. The support at the rear of the cradle answers a double purpose. It keeps the cradle rigid and at the same time holds the rear section of the chassis.

The bolt on this part is made of the same material that is used for the axles ($\frac{3}{16}$" drill rod). A thread must be cut on both ends with a 10/32 die. This same die is used for threading the ends of the axles. Use a piece of brass tubing as a spacer. Draw the nuts


BODY FRAME ASSEMBLY & CONSTRUCTION DETAILS
FIN PATTERN (1/4" SQUARES)
CUT FROM 3/8" PINE
SECTION
CUT TO FIT BODY CURVE
3/4" PINE OR HARDWOOD BLOCK CUT TO CURVE OF FRAME TOP
FRAME BRACE - MAKE 2 THUS OF 20GA. X 1/2" STEEL OR BRASS STRAP
DRILL AND TAP 6-32
1/2" R.H. WOODSCREW
1" F.H. WOODSCREW
DRILL 3/32" HOLE FOR 1/2" R.H. WOODSCREWS
B
A
1" F.H. WOODSCREWS COUNTERSINK HEADS AND PLUG HOLES FLUSH
FLAT
MAKE BRIDLE OF STIFF WIRE OR TO SUIT
NOTE-ENCIRCLED DIMENSIONS ARE FROM CENTER TO CENTER OF HOLES
BODY FRAME - SEE PATTERN FOR ADDITIONAL DIMENSIONS
SLOT FOR AXLE CLEARANCE - SEE PATTERN
DRILL 3/32" DIA HOLES FOR 1/2" R.H. WOODSCREWS
SLOT FOR CARBURETTER CLEARANCE (SEE PATTERN FOR BROWN 'E' MOTOR)
BRIDLE BRACKET - MAKE 2 THUS OF 20GA. X 1/2" STEEL OR BRASS STRAP
DRILL 1/8" DIA HOLE FOR BRIDLE
SECTION THRU BODY FRAMES

Sides are not alike, except in outline, and letters "A" and "B" correspond to similar letters on patterns on opposite page. Fin is primarily decorative and may be shaped any way you like.

on the outside up tight and the cradle will be rigid.

The holes for mounting the motor must be drilled so that they will fit for the particular motor used.

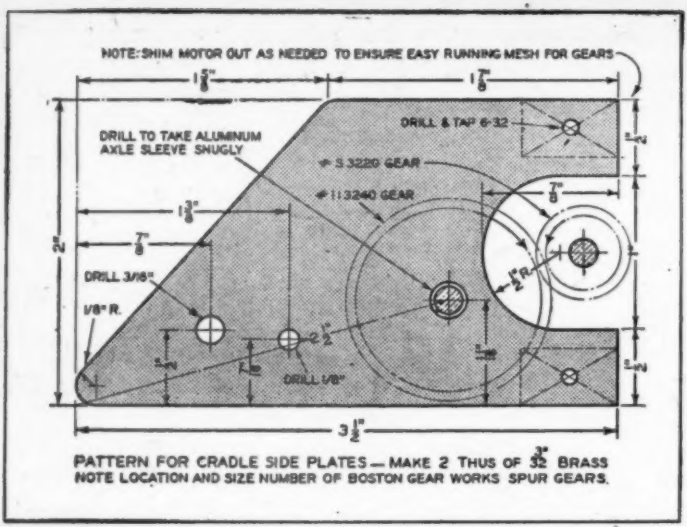
The remainder of the chassis is made of a piece of strap steel. The forward end of this part must ride free on the piece of tubing used as a spacer at the rear of the motor cradle. All the holes in this section should be made before assembly.

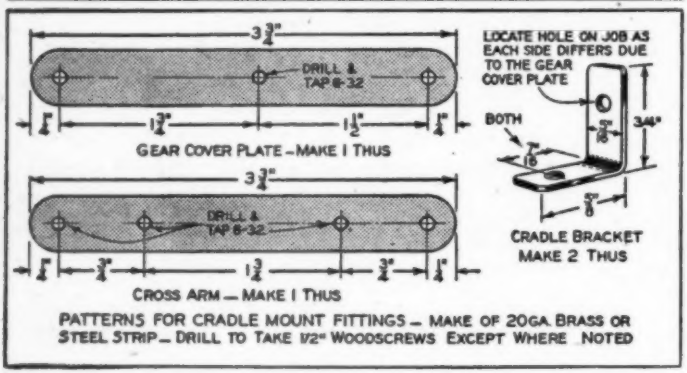
The axle bearing is made from a piece of aluminum (or other metal) tubing. The inside of the tubing should be a tight fit for the $\frac{3}{16}$" axle rod, and be reamed out for a perfect fit. Two small holes in the tubing provide a means of oiling. The ends of this bearing must force fit the holes provided for it in the motor cradle. The gears used are of the standard spur type. They may be had from the Boston Gear Works, North Quincy, Mass. They provide a two to one ratio which gives the model plenty of power and at the same time plenty of speed.

The numbers of the gears are S3220 and H3240. The smaller gear (S3220) has a ¼" hole which is the correct size to fit the motor shaft. The larger gear (H3240), however, is provided with a $\frac{3}{16}$" hole, so when ordering the gears also order a bushing for the H3240 to bring it down to $\frac{3}{16}$".

Pressure of the motor shaft nut against the flywheel holds the smaller gear in place. It is well to place a washer between the flywheel and the gear to provide plenty of clearance.

Before installing the larger gear it will be


NOTE: SHIM MOTOR OUT AS NEEDED TO ENSURE EASY RUNNING MESH FOR GEARS
DRILL TO TAKE ALUMINUM AXLE SLEEVE SNUGLY
DRILL & TAP 6-32
#3220 GEAR
#13240 GEAR
DRILL 3/16"
1/8" R.
DRILL 1/8"
PATTERN FOR CRADLE SIDE PLATES — MAKE 2 THUS OF 3/32 BRASS
NOTE LOCATION AND SIZE NUMBER OF BOSTON GEAR WORKS SPUR GEARS.


DRILL & TAP 6-32
GEAR COVER PLATE — MAKE 1 THUS
LOCATE HOLE ON JOB AS EACH SIDE DIFFERS DUE TO THE GEAR COVER PLATE
BOTH
3/4"
CRADLE BRACKET MAKE 2 THUS
DRILL & TAP 6-32
CROSS ARM — MAKE 1 THUS
PATTERNS FOR CRADLE MOUNT FITTINGS — MAKE OF 20GA. BRASS OR STEEL STRIP — DRILL TO TAKE 1/2" WOODSCREWS EXCEPT WHERE NOTED

MODELS

collars provide wheel rests. The rear wheels must, of course, be free running.

The wheels used are a standard variety sold by most model supply shops—Peerless class "A" wheels. The 3/16" axles just fit these wheels. If the wheels are not free on the rear axle go over it lightly with emery cloth until they fit perfectly. Be careful not to make the wheels too loose as this will cause them to wobble and decrease the speed of the car.

The flywheel may be had from the manufacturer of the motor. Each manufacturer has predetermined the correct flywheel for his motor and it is best to use the one specified.

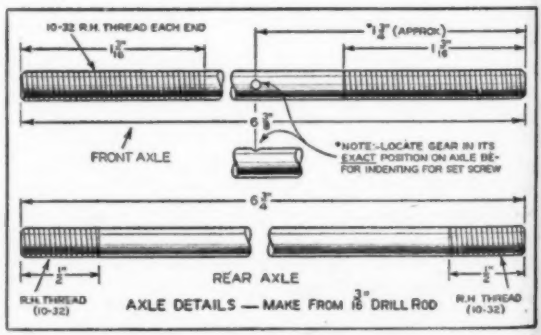
The frame of the car should be constructed of a hard or semi-hard wood. Before cutting the sides make sure that the front end extends beyond the top of the particular motor you intend to use.

necessary to drill a hole in the bushing to allow the free passage of the set screw contained in the gear hub. When installing this gear determine its exact position on the axle and the spot where the set screw will touch. At exactly this spot make a slight depression on the axle to receive the set screw. Do not make this hole too deep because it will weaken the axle.

The hub of the axle holds the gear on one side of the cradle and a 3/16" inside diameter collar holds it on the other side. These collars may be purchased in any radio supply store with the set screw already in them.

The rear axle is made with the same material as the front axle. Collars on the inside of the chassis hold the shaft in place, and two more

The sides of the frame are held together with two angles made of brass or steel strap. Before final assembly of the body make sure that the flywheel and gears do not rub


10-32 R.H. THREAD EACH END
"1 1/2" (APPROX)
FRONT AXLE
*NOTE:-LOCATE GEAR IN ITS EXACT POSITION ON AXLE BEFORE INDENTING FOR SET SCREW
REAR AXLE
R.H. THREAD (10-32)
AXLE DETAILS — MAKE FROM 3/16" DRILL ROD
R.H. THREAD (10-32)

Though steel drill rod will make the best axles, other materials, such as bronze, iron or brass may be used.

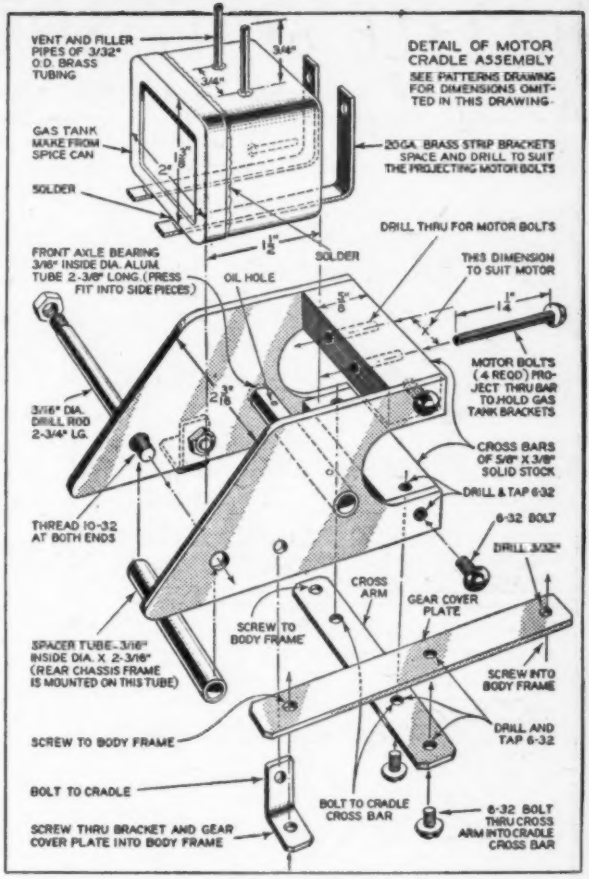
against the aperture provided for them.

Two small angle brackets suspended from the motor cradle and attached to the bottom of the sides of the frame in addition to a piece of steel or brass attached to the lower motor rest serve to hold the chassis in the frame.

In mounting the strip on the lower frame, drill and tap the rest with the 6-32 tap. Another short strip should be made to run across the lower part of the flywheel and gear opening. One end of the strip mentioned above should be bolted to this, and the other end attached to the opposite side of the frame with a wood screw.

The rear end of the chassis is attached to the frame only with springs. Those shown were cut from a length of spring sold as a curtain rod in five and ten cent stores. Two coils on the top are bent perpendicular to the main coil, to provide for the screw which will hold it to the frame. Two coils on the other end are enlarged and bent to fit the axle. By attaching these springs to the side of the body just above the rear axle slot, you create a floating rear end which will increase traction and riding quality on the bumps.

The gas tank shown was made from a discarded tin plate spice can. Any similar container that will fit the opening as shown will answer the purpose. At the lower corner of the tank solder a short piece of $\frac{3}{32}$" O.D. brass tubing.


DETAIL OF MOTOR CRADLE ASSEMBLY
SEE PATTERNS DRAWING FOR DIMENSIONS OMITTED IN THIS DRAWING
VENT AND FILLER PIPES OF 3/32" O.D. BRASS TUBING
GAS TANK MAKE FROM SPICE CAN
SOLDER
20GA. BRASS STRIP BRACKETS SPACE AND DRILL TO SUIT THE PROJECTING MOTOR BOLTS
DRILL THRU FOR MOTOR BOLTS
FRONT AXLE BEARING 3/16" INSIDE DIA. ALUM. TUBE 2-3/8" LONG. (PRESS FIT INTO SIDE PIECES)
OIL HOLE
THIS DIMENSION TO SUIT MOTOR
MOTOR BOLTS (4 REQD) PROJECT THRU BAR TO HOLD GAS TANK BRACKETS
3/16" DIA. DRILL ROD 2-3/4" LG.
CROSS BARS OF 5/8" X 3/8" SOLID STOCK
DRILL & TAP 6-32
THREAD 10-32 AT BOTH ENDS
6-32 BOLT
DRILL 3/32"
CROSS ARM
GEAR COVER PLATE
SCREW TO BODY FRAME
SPACER TUBE-3/16" INSIDE DIA. X 2-3/16" (REAR CHASSIS FRAME IS MOUNTED ON THIS TUBE)
SCREW INTO BODY FRAME
DRILL AND TAP 6-32
SCREW TO BODY FRAME
BOLT TO CRADLE
BOLT TO CRADLE CROSS BAR
6-32 BOLT THRU CROSS ARM INTO CRADLE CROSS BAR
SCREW THRU BRACKET AND GEAR COVER PLATE INTO BODY FRAME

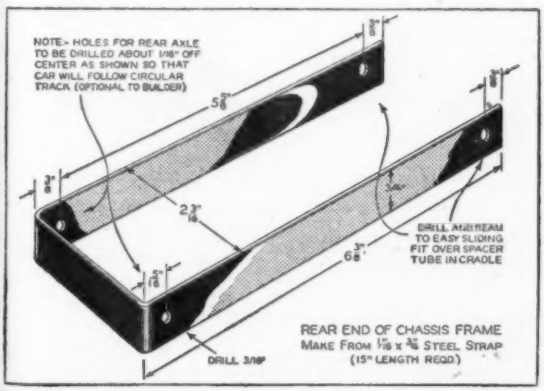
Motor cradle is very sturdy and will not be weakened by vibration. Gas tank fits compactly, held in place by same bolts that secure motor.

The can was cut down to a more adaptable size. The brass tubes shown on the top answer a double purpose; putting in fuel and allowing ventilation. An oil can with a small hole at the end of the spout will serve as a means of filling the tank.

The cover, of course, must be soldered on. Two brass brackets soldered to the tank provide a means of attaching it to the extended motor mount screws. A piece of neoprene tubing from the tank outlet to the carburetor inlet completes the fuel system.

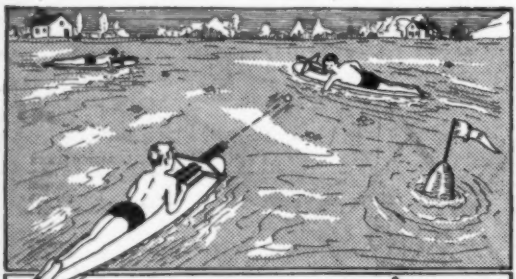
The coil and condenser provided

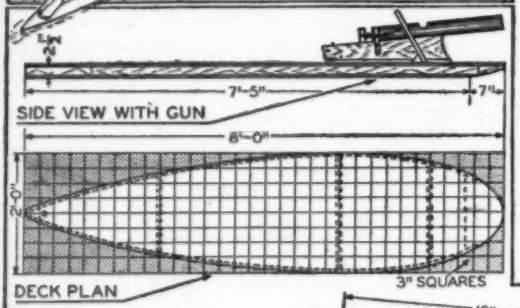
[*Continued on page* 164]

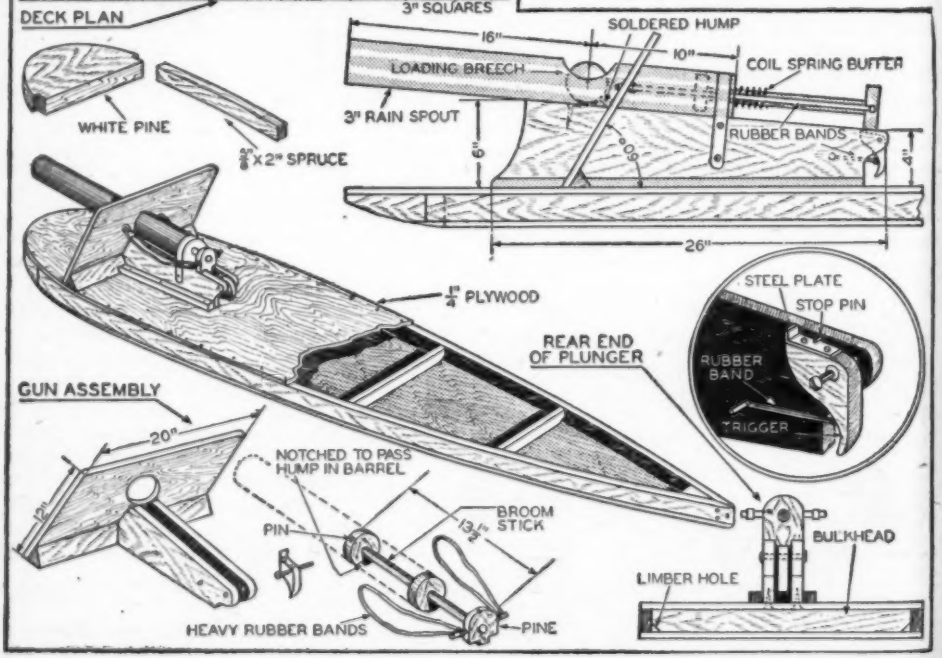

NOTE:- HOLES FOR REAR AXLE TO BE DRILLED ABOUT 1/16" OFF CENTER AS SHOWN SO THAT CAR WILL FOLLOW CIRCULAR TRACK (OPTIONAL TO BUILDER)
DRILL AND REAM TO EASY SLIDING FIT OVER SPACER TUBE IN CRADLE
DRILL 3/16"
REAR END OF CHASSIS FRAME
MAKE FROM 1/16 x 5/8 STEEL STRAP (15" LENGTH REQD.)

BATTLE of the SURF BOARDS

A LOT of fun may be had with two or more of these little naval craft which shoot balls made of cork, or discarded tennis or rubber balls, and which are aimed by maneuvering the paddle board into position. The guns being fixed, there is more sport in being able to get a bead on the "enemy." The gun can be made from cast-off material and is designed to be mounted on an existing paddleboard without damage to the latter. A wide plank of white pine or redwood can also be used, or if you wish to make a paddleboard anyway, the plans are given herewith—a rather broad model, shorter than standard, for economy in waterproof plywood. One panel 4 ft. by 8 ft. will suffice, with enough waste for the gun shield. Note that the rain-spout gun barrel has an opening in the top, forward of the shield, into which the tennis ball is placed, and a small tin strip in the form of a hump is soldered in to keep the ball from rolling back against the plunger. No harm if it does, of course, but the force will be greater if the ball is struck after the plunger has attained full velocity. A notch in the plunger permits it to slide over the hump. Screen door springs may be substituted for the rubber band fire power.—*Hi Sibley.*







WEATHERPROOF YOUR 'CYCLE

by Ivan J. Stretten

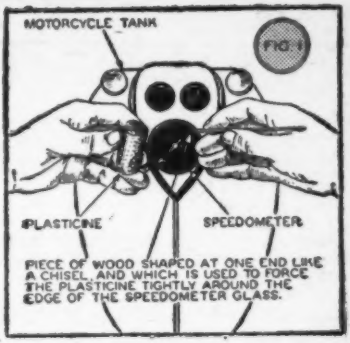
SHELLAC, rubber cement, and plasticine, are the chief materials required for a good weatherproofing job on your motorcycle. In fact, by following these simple instructions you can effectively weatherproof almost any engine to be used out of doors, from the smallest lightweight outboard to the family automobile.

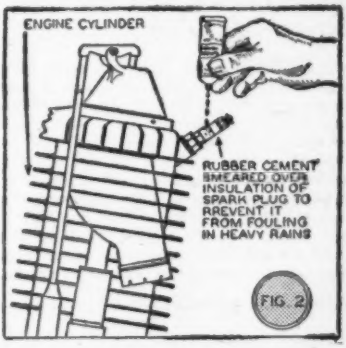
In the case of the motorcycle, exposed gauges and instruments such as ammeter, speedometer, etc., should be waterproofed with plasticine (see Fig. 1). A chisel shaped piece of wood should be used to apply plasticine around the rim of the glass. On your car this same material is also handy for stopping minor leaks around window frames, etc.

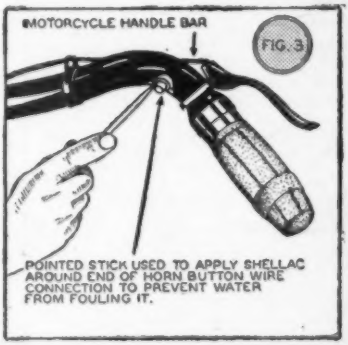
The ignition system calls for rubber cement, or the usual tire cement of similar nature. The entire top end of the spark plugs should be liberally coated with the cement and allowed to dry. The spark plug lead should be connected to the plug before the cement is applied, so that the metal nut or clip at the top of the plug can also be coated. (See Fig. 2.)

Where leads enter the magneto on the motorcycle, or the distributor on other types of motors, they should be bound tightly with friction tape as shown in Fig. 5, and smeared with thick shellac at the lower end of the binding to prevent water from seeping in. Shellac should also be applied to the end of the horn button wire on the handlebars to eliminate the possibility of shorts in wet weather. (Fig. 3.)

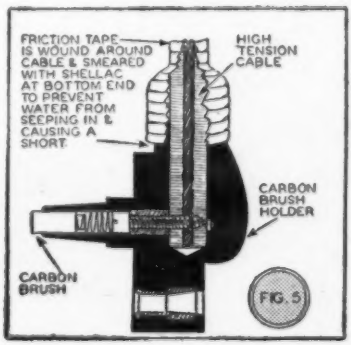
All flexible control cables should be carefully greased both for lubrication and protection from rust and corrosion at the points where they are exposed at handles, control arms, etc., as indicated in Fig. 4. If the motorcycle is to be stored for any length of time it is advisable to coat all plated parts with oil or grease, as it is possible for rust to attack even though the metal is plated.


MOTORCYCLE TANK
FIG. 1
PLASTICINE
SPEEDOMETER
PIECE OF WOOD SHAPED AT ONE END LIKE A CHISEL, AND WHICH IS USED TO FORCE THE PLASTICINE TIGHTLY AROUND THE EDGE OF THE SPEEDOMETER GLASS.



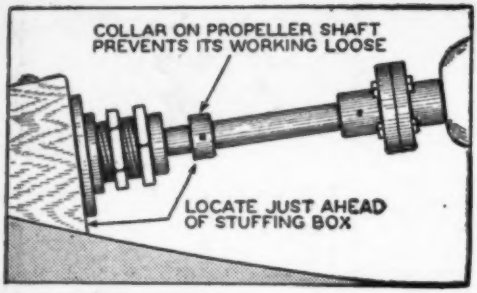

MOTORCYCLE HANDLE BAR
FIG. 3
POINTED STICK USED TO APPLY SHELLAC AROUND END OF HORN BUTTON WIRE CONNECTION TO PREVENT WATER FROM FOULING IT.

The correct methods of applying waterproofing material to the motorcycle parts are shown in the drawings at the right. The same procedure can be used on similar automobile parts where exposed. The instrument panel of open or convertible cars can be protected from damage by rain water in the same manner as the instruments on motorcycles.


FRICTION TAPE IS WOUND AROUND CABLE & SMEARED WITH SHELLAC AT BOTTOM END TO PREVENT WATER FROM SEEPING IN & CAUSING A SHORT
HIGH TENSION CABLE
CARBON BRUSH HOLDER
CARBON BRUSH
FIG. 5

CONTROL CABLE HOUSING
CONTROL CABLE SLOT AND JOINT WHICH SHOULD BE FILLED WITH GREASE OR HARD OIL TO KEEP OUT WATER AND ROAD DUST
FRONT BRAKE CONTROL LEVER
HANDLE BAR
FIG. 4

SHIP SHAPERS



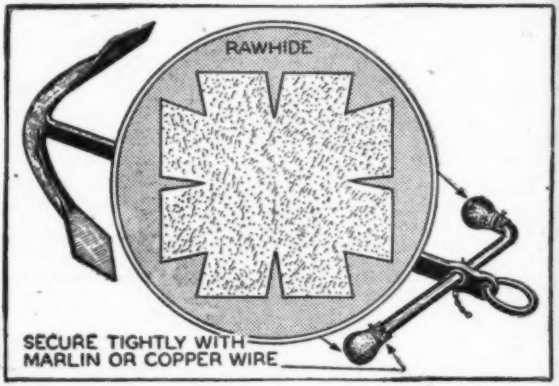
Collar On Propeller Shaft

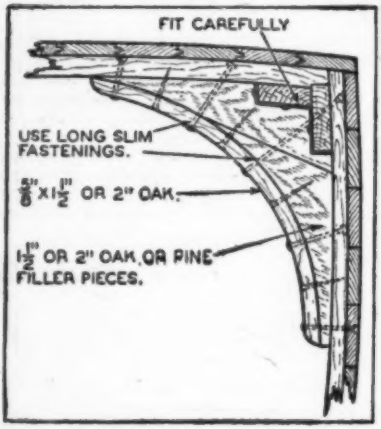
WHEN any auxiliary is under sail there is considerable pull against the blades of the propeller, sometimes causing the shaft to pull out of its coupling.

This may never happen to you but it is easily and cheaply guarded against. Simply have a collar on the shaft between the stuffing box cap and the engine coupling, locating it far enough from the former not to interfere with repacking, yet close enough to hold the shaft from working very far aft should it pull out.

Rawhide On Anchor Saves Topsides

IN GETTING your heavy or emergency anchor on deck, the balls of the stock ends usually mar the paint of the topsides at the bow even when handled with a lifting line or cathook about a fluke. This can be avoided by covering each ball with rawhide leather, merely notching out corners of large enough squares, then gathering the corners about the stock and serving tightly with marlin or copper wire. Wetting will shrink the rawhide tightly in place and give effective protection for an entire season.





Laminated Knees

WHEN regular hackmatack knees cannot be secured or are too expensive, laminated ones are easily made and can be used for strengthening members wherever required.

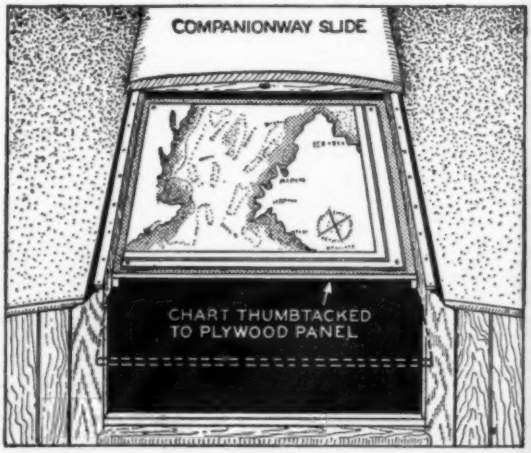
Lay the exact shape of the knee out on cardboard, then cut out for use as a form pattern to bend the outside oak member over. This should have more curve than necessary as any excess

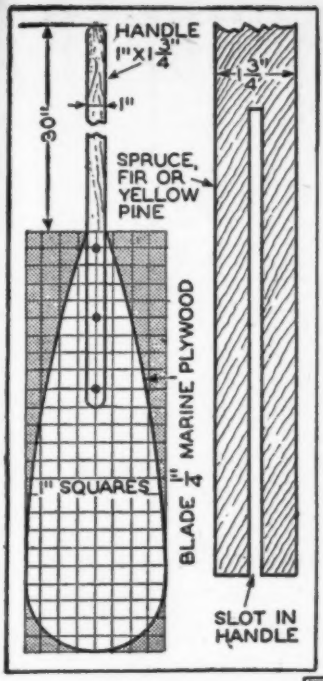
[*Continued on page 161*]

Protecting Chart

HERE'S an easy way to have your chart handy but well protected during wet weather. Cut a panel of plywood large enough to be a sliding fit in the cabin companionway, setting it on top of the usual trim there or on neat strips fastened for the purpose.

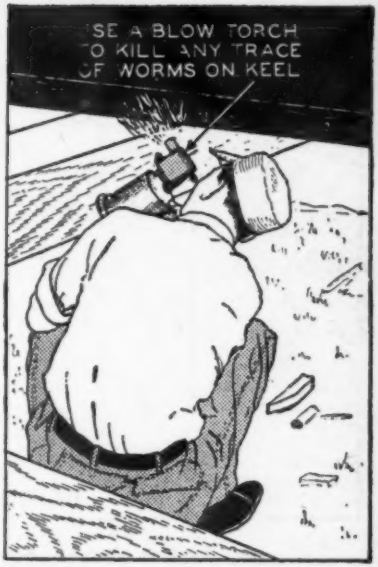
The chart is folded and thumb tacked to this with the section on which you are working uppermost. In wet weather or with spray flying the slide is naturally kept closed protecting the chart, but it can be quickly looked at by either shoving the slide back or partially pulling out the panel.





Torch Kills Worms

IF YOUR keel shows any trace of worms use a blow torch to kill these by playing its intense flame over suspicious looking places. Always take this precaution before renewing a worn shoe on a boat used in salt water, as using the blow torch also dries out the wood for coating with copper paint or whatever you're using before fitting the new shoe.



Easily Made Paddle

THE paddle at left utilizes waterproof plywood for the blade, while any lightweight strong wood such as spruce, fir or yellow pine is best for the handle. Screw fasten or rivet the joint together and apply three coats of varnish.

Centerboard Hanger

TO REMOVE the centerboard from most cabin boats for coppering or repairs, the pin or bolt on which the board pivots must be withdrawn and the board floated out while the boat is in the water. However fast you work with plugs to stop the rush of water through the bolt holes a lot is bound to get in the boat.

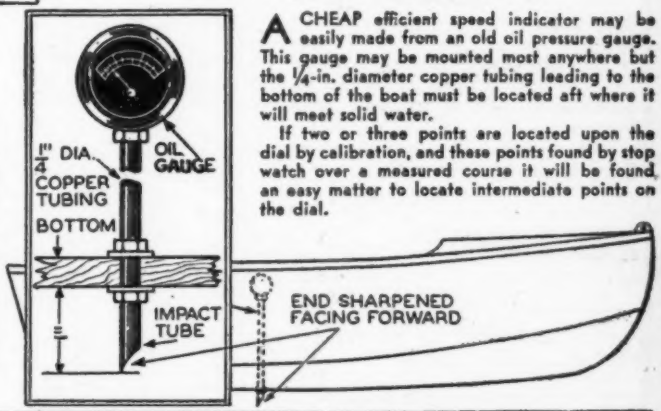
The hanger fitting shown avoids this trouble. The rod flattened and bored at its lower end merely

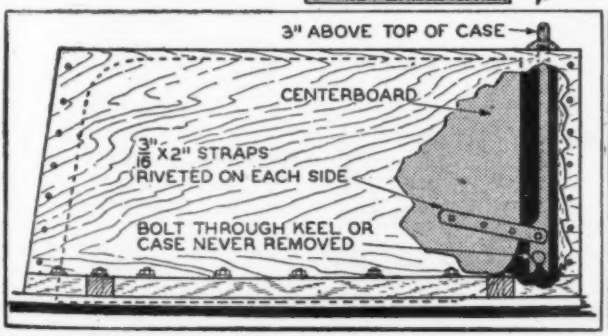
[*Continued on page 152*]

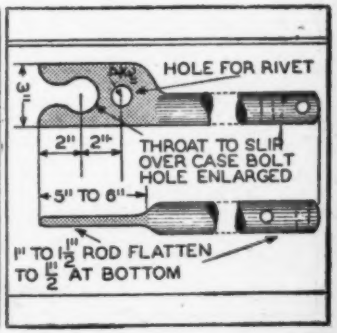
Speed Indicator

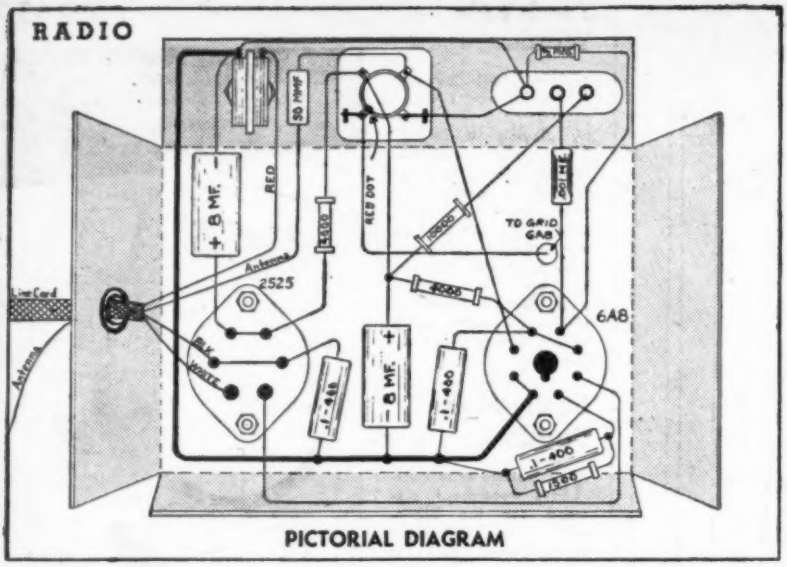
A CHEAP efficient speed indicator may be easily made from an old oil pressure gauge. This gauge may be mounted most anywhere but the 1/4-in. diameter copper tubing leading to the bottom of the boat must be located aft where it will meet solid water.

If two or three points are located upon the dial by calibration, and these points found by stop watch over a measured course it will be found an easy matter to locate intermediate points on the dial.









PICTORIAL DIAGRAM

Left: How the parts are located on the underside of the chassis panel. The latter is bent along dotted lines and the top section represents the actual front of the set. At bottom of page is schematic diagram.

2 Tube Baby Broadcaster

[*Continued from page* 105]

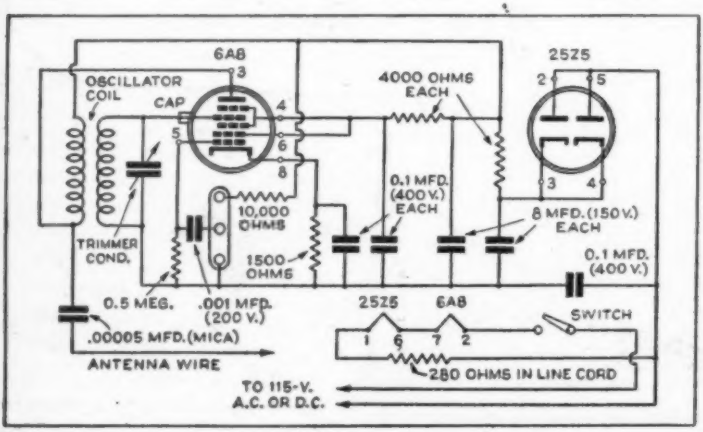
voltage, all of the other functions of the broadcast station are performed by the one tube—the 6A8. The 6A8 tube is a multi-grid tube and generally used as a converter in super-heterodyne receivers. The multi-grid arrangement of this tube is taken advantage of in this circuit rather cleverly. All of the elements of the tube, except the grid next to the cathode, are used to produce R. F. oscillation in the broadcast band. The oscillator circuit is standard and easily understood by those of you acquainted with radio circuits. The remaining grid is used for "modulation." When the voltage developed by the phono pickup or the microphone is impressed on this grid, the electron stream passing from the cathode to the other elements is modulated. The result is a modulated R. F. carrier transmitted by the antenna of the oscillator.

Before you begin construction of the broadcast station, be sure that you have all of the parts. The oscillator coil listed in the parts list was especially designed for this unit. A drilled and formed chassis is available, saving you the job of making your own.

Either the schematic or the pictorial diagram may be followed in wiring. The pictorial diagram will be found easier to follow for those of you who have not had too much radio wiring experience. Too, the pictorial diagram shows the actual layout of parts to aid you in the assembly.

When wiring the oscillator, all of the connec-

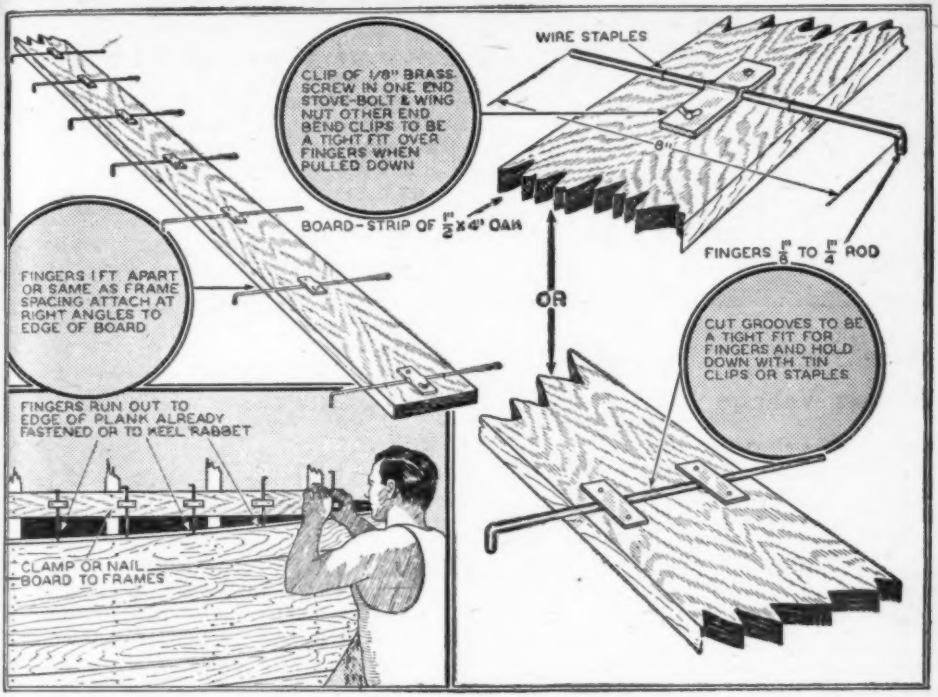
[*Continued on page* 162]



Parts List

1 Drilled and formed chassis (Allied 2N925)
1 Small grid cap
1 Line cord resistor and antenna (Allied 49-523)
1 Special oscillator coil with tuning condenser (Allied 2N279)
1 S.P.S.T. toggle switch
1 3 screw input terminal (Knight)
1 6 prong wafer socket (Knight)
1 Octal wafer socket (Knight)
2 8 mfd 150 volt tubular electrolytic condensers
3 .1 mfd 400 volt tubular paper condensers (Knight)
1 .00005 mfd mica condenser (Knight)
1 .001 mfd 400 volt paper tubular condenser (Knight)
2 4,000 ohm ½ watt resistors (Knight)
1 100,000 ohm ½ watt resister (Knight)
1 10,000 ohm ½ watt resistor (Knight)
1 1,500 ohm ½ watt resistor (Knight)
1 Knight 6A8 tube (Allied 9-089)
1 Knight 2525 tube (Allied 9-260)
Miscellaneous hardware, wire and solder (Allied 2N924)

ADJUSTABLE SPILING BOARD


CLIP OF 1/8" BRASS. SCREW IN ONE END STOVE-BOLT & WING NUT OTHER END BEND CLIPS TO BE A TIGHT FIT OVER FINGERS WHEN PULLED DOWN
WIRE STAPLES
8"
BOARD - STRIP OF 1/2 X 4" OAK
FINGERS 1/8 TO 1/4 ROD
FINGERS 1FT. APART OR SAME AS FRAME SPACING ATTACH AT RIGHT ANGLES TO EDGE OF BOARD
OR
CUT GROOVES TO BE A TIGHT FIT FOR FINGERS AND HOLD DOWN WITH TIN CLIPS OR STAPLES
FINGERS RUN OUT TO EDGE OF PLANK ALREADY FASTENED OR TO KEEL RABBET
CLAMP OR NAIL BOARD TO FRAMES

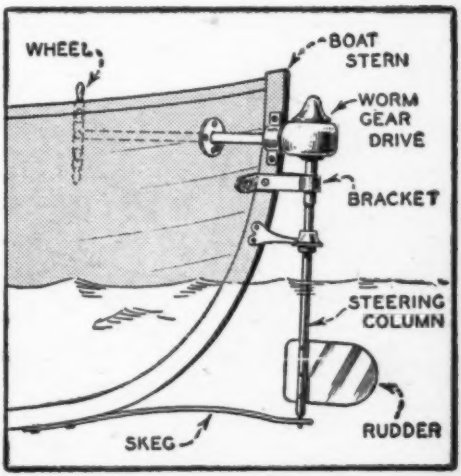
FOR planking a boat 20 ft. or over in length, either a chine or round-bilge model, time will be saved and a tighter, better-looking job had by using a spiling board with adjustable fingers to secure the correct shapes of planks.

For temporary use a simple type as shown is satisfactory. The principle is that the fingers are run out to give the space between the spiling board and the already fastened plank or the rabbet, whichever you are fitting to, and then used to transfer these distances or points to the actual board rather than depend on using a rule or dividers to take measurements.

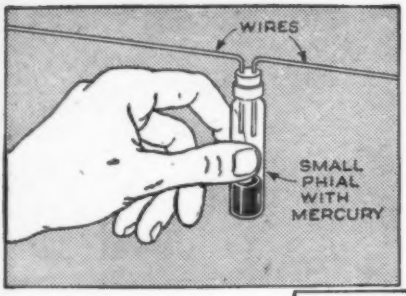
[*Continued on page 168*]

Worm Gear Helm

AN ORDINARY automobile worm and sector steering unit makes an excellent boat steering arrangement when mounted as shown. The steering shaft is run through the stern of the boat as shown, and sawed off inside at the desired length. The boat wheel is then mounted the same as the auto steering wheel. The steering arm shaft of the worm unit is brazed or otherwise fastened to the rudder shaft. Brackets support it all.—*L. B. R.*



ELECTRIKINKS



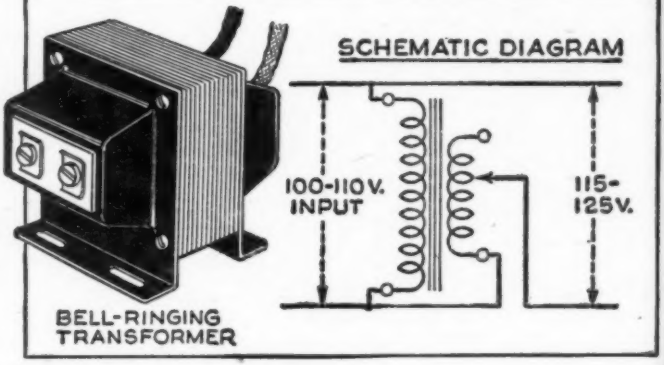
Improvised Mercury Switch

TWO copper wires driven through a small cork, a bit of mercury and a small phial can be quickly served up into a rather useful mercury switch that will handle 3 or 4 amperes at 110 volts and that will bear up for a considerable length of time. If necessary, the phial may be mounted on board and the board arranged with a swivel so that the mercury can be shifted from one end of the tube to the other.

Transformer Adjusts Voltage

USING an ordinary bell-ringing transformer and a few strips of wire, this quickly fashioned hookup steps up low line-voltage and increases the speed of small, motor-driven devices such as electric razors and lathe-grinders. By reversing two connections, line-voltage may similarly be reduced in localities where it is too high.

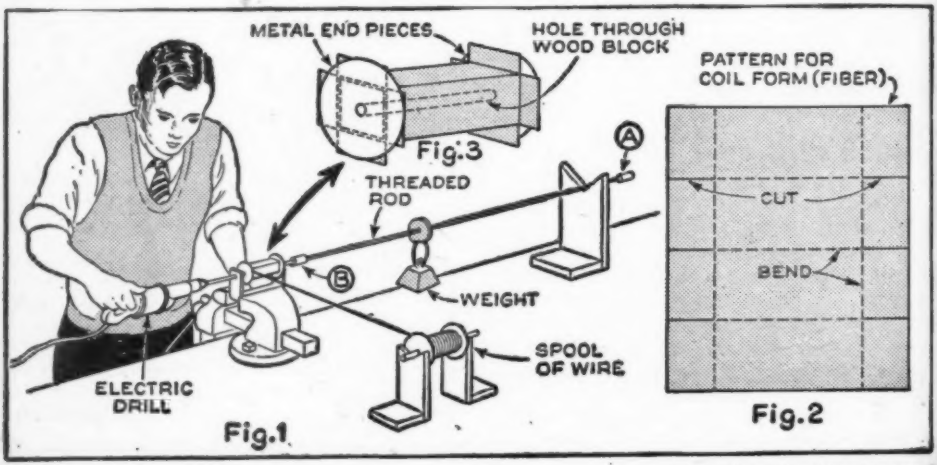
As shown in the schematic diagram, part or all of the low-voltage secondary is connected in series and in phase with the 110 volt line. The voltage adjustment range depends only on the number of available taps on the secondary winding of the transformer.—G. R. S.



Speed Winding Of Coils

SPEED winding of coils such as are used on solenoid valves and the starting relays of switches may be easily accomplished with a portable drill as shown in the accompanying sketch. A piece of strap iron is bent in the form of a U and ¼" holes drilled in line

[*Continued on page* 174]



Seedlings In Electric Hotbed

[*Continued from page 107*]

necessary to cover the hotbed with a mat, old blanket or piece of burlap. A vent of 3" stove pipe may be used to allow heat to raise from heater space, to prevent freezing plant tops. The sides and ends of the hotbed should be covered with tar paper and then banked with earth and cinders.

The compartments of the type using heating units should be enclosed with doors on the front. The back should be closed with a 1"x4"x12' board. The doors and wiring may be placed at either the front or rear of the hotbed, whichever is preferred.

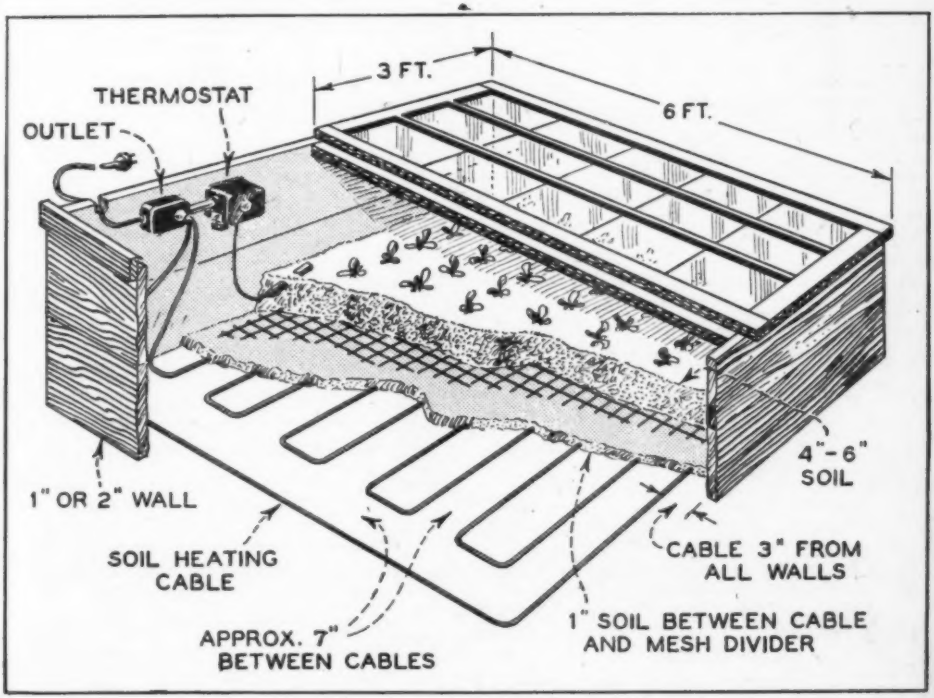
It is much easier to install and use the cable heating kit, which consists of 60 feet of cable, with a core of No. 19 resistance wire, capable of warming 36 square feet of hotbed space. The cable is covered with layers of felted asbestos and lead-jacketed to protect it from moisture. Any soil temperature between 30 and 100 degrees can be maintained by the automatic control device. From 55 to 80 degrees is the most common temperature used. The following is the minimum safe temperature for common vegetables:

Vegetable	Degree of Temperature
Lettuce	59-68
Cauliflower	50-68
Celery	57-75
Tomatoes	63-75
Radishes	50-59
Peas	50-68
Cucumbers	72-82
Parsley	57-72

The more common types of flowering annuals can be germinated from seed and developed into plants for transplanting without danger of low temperature if the thermostat is set to turn on current when the temperature drops below 50 degrees.

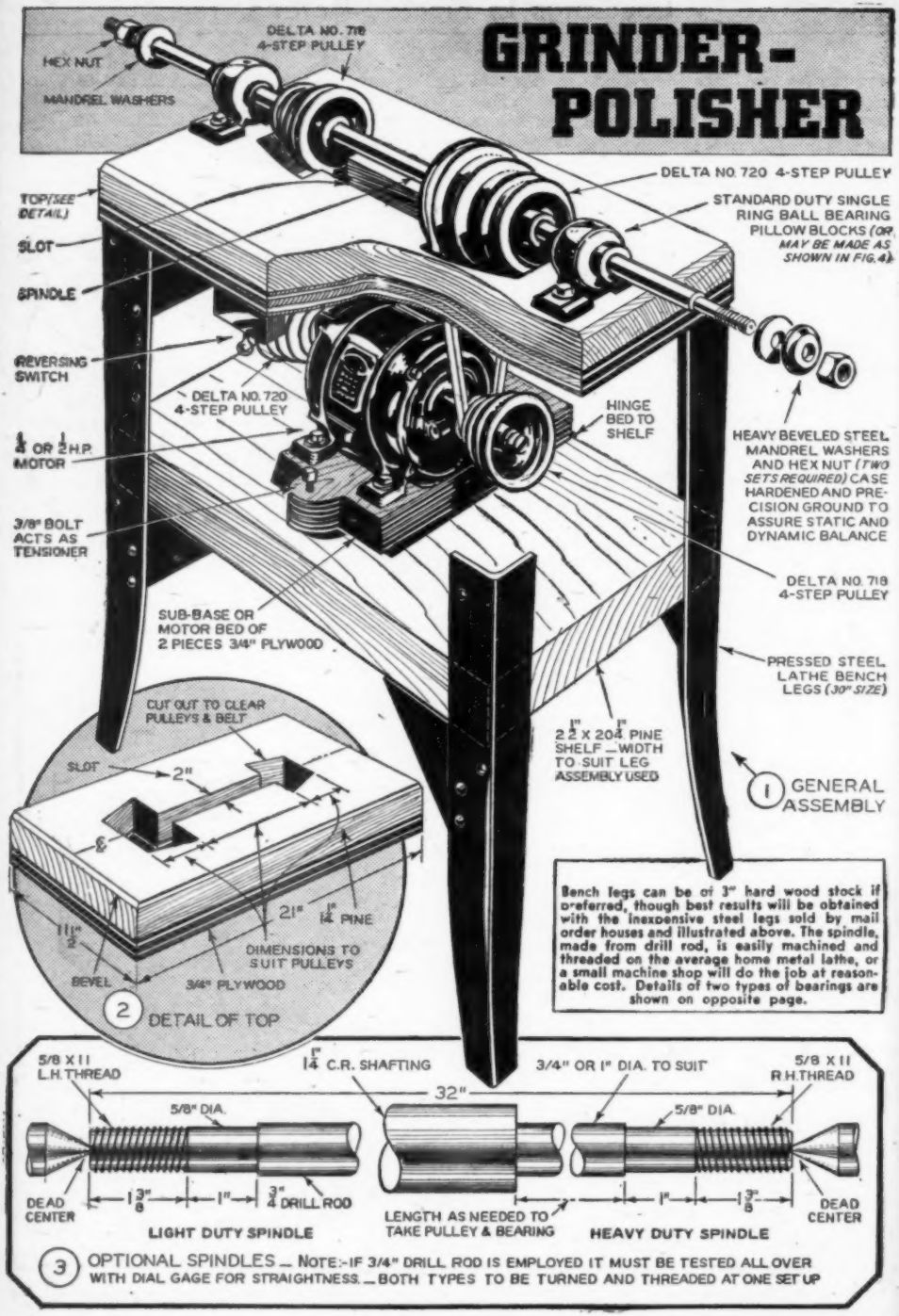
In installing the cable kit in the hotbed, the cable is placed in the bottom of the soil, before earth is placed in the bed; it is laid in parallel lines about 7" apart and looped at the ends of the bed so that the wire is in one length. The sensitive thermostat control bulb is partly buried in the soil, to permit warmth of the sun's rays to help operate the temperature control. About 200 watts is carried through the cable in each 3'x6' hotbed. After the cable has been placed in position, from 3" to 6" of rich soil is placed on top and the bed is

[*Continued on page 166*]



Drawing above shows third type of hotbed. In this one heating cable is run through a layer of earth directly beneath the planting soil, separated from the latter by a mesh screen.

GRINDER-POLISHER


HEX NUT
MANDREL WASHERS
DELTA NO. 718 4-STEP PULLEY
DELTA NO. 720 4-STEP PULLEY
STANDARD DUTY SINGLE RING BALL BEARING PILLOW BLOCKS (OR, MAY BE MADE AS SHOWN IN FIG. 4)
TOP (SEE DETAIL)
SLOT
SPINDLE
REVERSING SWITCH
DELTA NO. 720 4-STEP PULLEY
HINGE BED TO SHELF
1/4 OR 1/2 H.P. MOTOR
3/8" BOLT ACTS AS TENSIONER
HEAVY BEVELED STEEL MANDREL WASHERS AND HEX NUT (TWO SETS REQUIRED) CASE HARDENED AND PRECISION GROUND TO ASSURE STATIC AND DYNAMIC BALANCE
DELTA NO. 718 4-STEP PULLEY
SUB-BASE OR MOTOR BED OF 2 PIECES 3/4" PLYWOOD
PRESSED STEEL LATHE BENCH LEGS (30" SIZE)
1" x 2" x 20" PINE SHELF — WIDTH TO SUIT LEG ASSEMBLY USED
1 GENERAL ASSEMBLY
CUT OUT TO CLEAR PULLEYS & BELT
SLOT
2"
21"
1/4" PINE
11 1/2"
DIMENSIONS TO SUIT PULLEYS
BEVEL
3/4" PLYWOOD
2 DETAIL OF TOP
Bench legs can be of 3" hard wood stock if preferred, though best results will be obtained with the inexpensive steel legs sold by mail order houses and illustrated above. The spindle, made from drill rod, is easily machined and threaded on the average home metal lathe, or a small machine shop will do the job at reasonable cost. Details of two types of bearings are shown on opposite page.
5/8 X 11 L.H. THREAD
1/4" C.R. SHAFTING
3/4" OR 1" DIA. TO SUIT
5/8 X 11 R.H. THREAD
32"
5/8" DIA.
5/8" DIA.
DEAD CENTER
1 3/8"
1"
3/4" DRILL ROD
LIGHT DUTY SPINDLE
LENGTH AS NEEDED TO TAKE PULLEY & BEARING
1"
1 3/8"
DEAD CENTER
HEAVY DUTY SPINDLE
3 OPTIONAL SPINDLES — NOTE:- IF 3/4" DRILL ROD IS EMPLOYED IT MUST BE TESTED ALL OVER WITH DIAL GAGE FOR STRAIGHTNESS — BOTH TYPES TO BE TURNED AND THREADED AT ONE SET UP

COMBINATION FOR YOUR WORKSHOP

by Clyde Baker

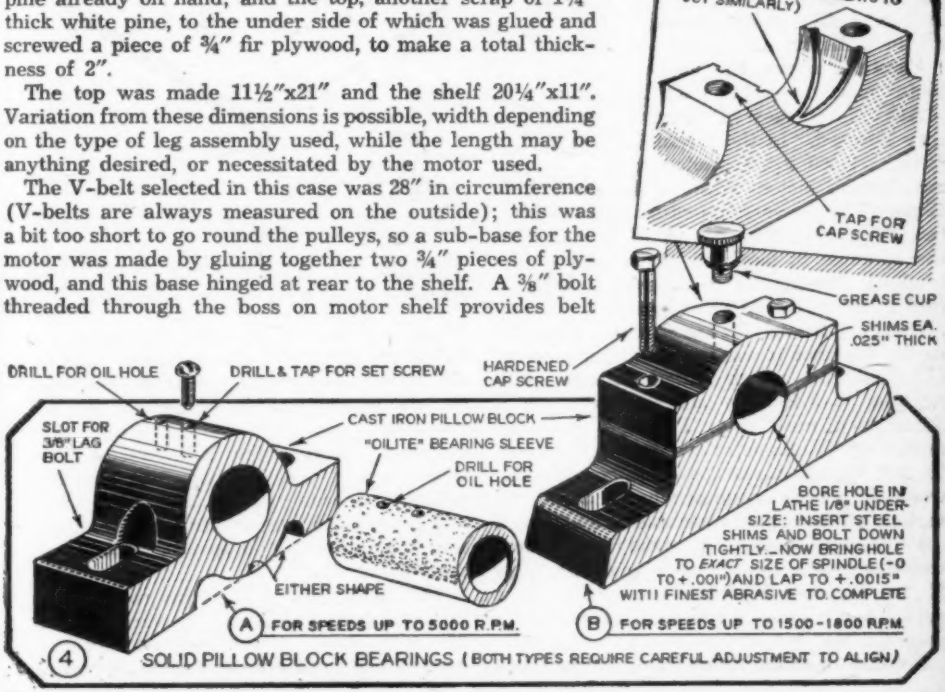
THE small production shop, or the basement home shop, will find this tool equally valuable—valuable far in excess of its relatively low cost; while larger shops can afford to use a number of them. Easily assembled by anyone who can do elementary lathe work, it covers a wide field of usefulness, in the manufacturing plant, experimental shop, or laboratory.

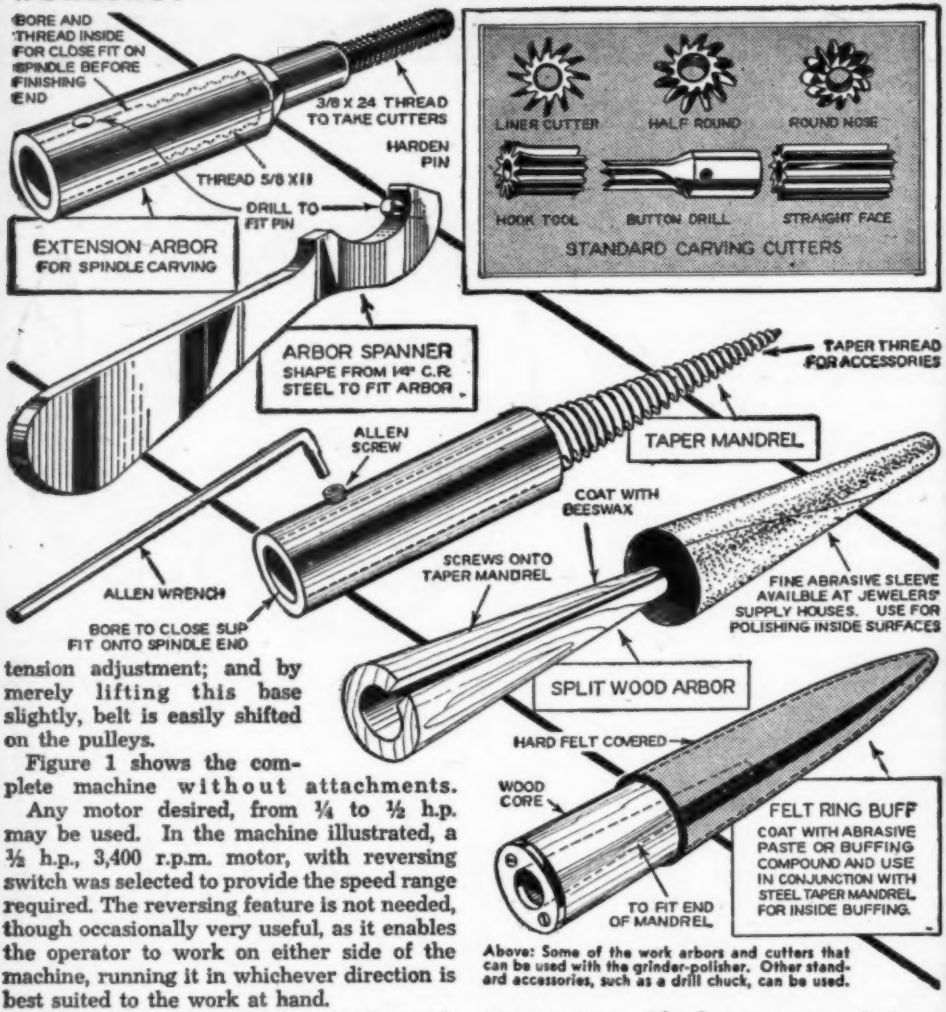
The stand may be built of yellow pine, maple, or oak lumber, with legs 3" square; though it was found quicker and less expensive to use a set of the pressed steel lathe bench legs sold by Sears Roebuck.

For maximum solidity and to prevent vibration, top and motor shelf were made extra thick; shelf being a piece of 2½" thick white pine already on hand; and the top, another scrap of 1¼" thick white pine, to the under side of which was glued and screwed a piece of ¾" fir plywood, to make a total thickness of 2".

The top was made 11½"x21" and the shelf 20¼"x11". Variation from these dimensions is possible, width depending on the type of leg assembly used, while the length may be anything desired, or necessitated by the motor used.

The V-belt selected in this case was 28" in circumference (V-belts are always measured on the outside); this was a bit too short to go round the pulleys, so a sub-base for the motor was made by gluing together two ¾" pieces of plywood, and this base hinged at rear to the shelf. A ⅜" bolt threaded through the boss on motor shelf provides belt


CUT GREASE GROOVES WITH SMALL WHEEL IN HAND TYPE GRINDER (BOTH SEGMENTS TO CUT SIMILARLY)
TAP FOR CAP SCREW
GREASE CUP
SHIMS EA. .025" THICK
DRILL FOR OIL HOLE
DRILL & TAP FOR SET SCREW
HARDENED CAP SCREW
SLOT FOR 3/8" LAG BOLT
CAST IRON PILLOW BLOCK
"OILITE" BEARING SLEEVE
DRILL FOR OIL HOLE
EITHER SHAPE
BORE HOLE IN LATHE 1/8" UNDER-SIZE: INSERT STEEL SHIMS AND BOLT DOWN TIGHTLY...NOW BRING HOLE TO EXACT SIZE OF SPINDLE (-0 TO +.001") AND LAP TO +.0015" WITH FINEST ABRASIVE TO COMPLETE
A FOR SPEEDS UP TO 5000 R.P.M.
B FOR SPEEDS UP TO 1500-1800 R.P.M.
4 SOLID PILLOW BLOCK BEARINGS (BOTH TYPES REQUIRE CAREFUL ADJUSTMENT TO ALIGN)


BORE AND THREAD INSIDE FOR CLOSE FIT ON SPINDLE BEFORE FINISHING END
3/8 X 24 THREAD TO TAKE CUTTERS
HARDEN PIN
THREAD 5/8 X 11
DRILL TO FIT PIN
EXTENSION ARBOR FOR SPINDLE CARVING
LINER CUTTER
HALF ROUND
ROUND NOSE
HOOK TOOL
BUTTON DRILL
STRAIGHT FACE
STANDARD CARVING CUTTERS
ARBOR SPANNER SHAPE FROM 1/4" C.R. STEEL TO FIT ARBOR
TAPER THREAD FOR ACCESSORIES
ALLEN SCREW
TAPER MANDREL
COAT WITH BEESWAX
SCREWS ONTO TAPER MANDREL
ALLEN WRENCH
BORE TO CLOSE SLIP FIT ONTO SPINDLE END
FINE ABRASIVE SLEEVE AVAILBLE AT JEWELERS' SUPPLY HOUSES. USE FOR POLISHING INSIDE SURFACES
SPLIT WOOD ARBOR
HARD FELT COVERED
WOOD CORE
FELT RING BUFF
COAT WITH ABRASIVE PASTE OR BUFFING COMPOUND AND USE IN CONJUNCTION WITH STEEL TAPER MANDREL FOR INSIDE BUFFING.
TO FIT END OF MANDREL

Above: Some of the work arbors and cutters that can be used with the grinder-polisher. Other standard accessories, such as a drill chuck, can be used.

tension adjustment; and by merely lifting this base slightly, belt is easily shifted on the pulleys.

Figure 1 shows the complete machine without attachments.

Any motor desired, from ¼ to ½ h.p. may be used. In the machine illustrated, a ½ h.p., 3,400 r.p.m. motor, with reversing switch was selected to provide the speed range required. The reversing feature is not needed, though occasionally very useful, as it enables the operator to work on either side of the machine, running it in whichever direction is best suited to the work at hand.

Details of the spindle are shown in Figure 3. In this instance it was made from a piece of ¾" drill rod, which usually comes quite straight, and is very stiff, necessitating a minimum of machining. For light work, ½" instead of ⅝" diameter could well be chosen for the threaded ends, as this smaller size would fit a wide range of wheels, buffs, and various attachments obtainable at small cost.

For heavier work, or in steady production, would suggest a spindle made as shown (also Figure 3), from 1¼" shafting, with a light cut taken from end to end, to assure complete accuracy and balance.

Spindle must be turned and finished between centers. The first one we made from ¾" drill rod proved unsatisfactory, because the lathe used would not take it between centers, so each end was turned and threaded separately in a chuck. Would have worked out all right, but for the unsuspected fact that this piece of drill rod was not absolutely straight. A bend of even .001" in the spindle will cause excessive vibration and render the machine useless at all speeds. *This spindle must be straight.*

The matter of bearings was recognized as all important, and gone into very carefully. The final choice, which has never been regretted, was the Fafnir single row ball bearing

pillow block Model SAK-¾". The same type should be chosen in 1" size for the heavier spindle shown in Figure 3. Suitable combinations of pulleys may be used to give the speeds desired, and the bearing manufacturers should *always* be consulted as to the correct type of ball bearing pillow blocks to be used. The so-called "heavy duty" ball bearing pillow blocks are not recommended for high speeds, but rather, for prolonged service at low to moderate speeds.

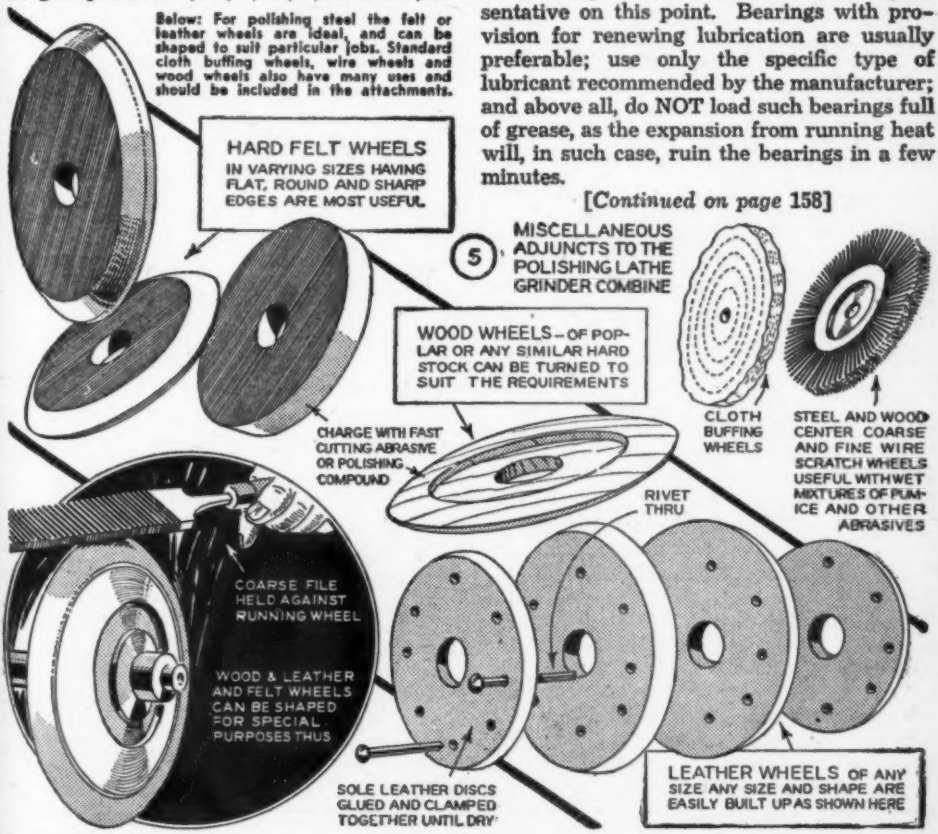
In the machine illustrated we desired the greatest speed range possible, so took advantage of the double-end motor spindle by choosing the Delta Nos. 718 and 720, 4-step cone pulleys with ¾" bore, two pulleys of each size being used. The two belt holes in table top are connected by a slot two inches wide under the spindle, so that belt may be shifted to either set of pulleys as required. With belt at right end, as shown in picture, we get speeds of 1,300, 2,000, 2,600 and 3,450 r.p.m., with 3,450 r.p.m. motor; and with belt shifted to left end pulleys, speeds of 3,450, 4,800, 6,800, and 10,000 r.p.m. With a 1,750 r.p.m. motor, these speeds would be cut in half—a desirable reduction for certain types of work.

This machine was not designed for wheels or buffs larger than 6" to 7" diameter; and for these the three lower speeds were found best adapted. For small buffs, spindle ring-buffs, and very small grinder wheels of 2" and under, the higher speeds are desirable. For use with carving cutters the speed of 10,000 r.p.m. is essential, and this speed should not be maintained for more than 10 to 15 minutes with the bearings used.

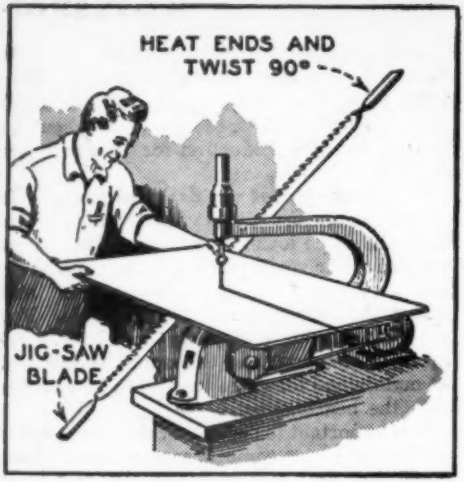
It is important to remember that some types of ball bearings come grease-packed, while others are only lightly lubricated, and have provision for renewing lubrication. It is important to obtain accurate information from the bearing manufacturer's dealer or representative on this point. Bearings with provision for renewing lubrication are usually preferable; use only the specific type of lubricant recommended by the manufacturer; and above all, do NOT load such bearings full of grease, as the expansion from running heat will, in such case, ruin the bearings in a few minutes.

[*Continued on page* 158]

Below: For polishing steel the felt or leather wheels are ideal, and can be shaped to suit particular jobs. Standard cloth buffing wheels, wire wheels and wood wheels also have many uses and should be included in the attachments.

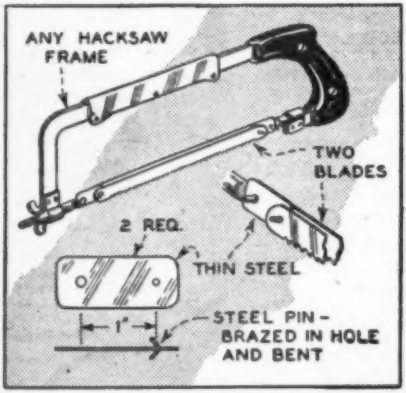

HARD FELT WHEELS
IN VARYING SIZES HAVING FLAT, ROUND AND SHARP EDGES ARE MOST USEFUL
5
MISCELLANEOUS ADJUNCTS TO THE POLISHING LATHE GRINDER COMBINE
WOOD WHEELS—OF POPLAR OR ANY SIMILAR HARD STOCK CAN BE TURNED TO SUIT THE REQUIREMENTS
CLOTH BUFFING WHEELS
STEEL AND WOOD CENTER COARSE AND FINE WIRE SCRATCH WHEELS USEFUL WITH WET MIXTURES OF PUMICE AND OTHER ABRASIVES
CHARGE WITH FAST CUTTING ABRASIVE OR POLISHING COMPOUND
RIVET THRU
COARSE FILE HELD AGAINST RUNNING WHEEL
WOOD & LEATHER AND FELT WHEELS CAN BE SHAPED FOR SPECIAL PURPOSES THUS
SOLE LEATHER DISCS GLUED AND CLAMPED TOGETHER UNTIL DRY
LEATHER WHEELS OF ANY SIZE ANY SIZE AND SHAPE ARE EASILY BUILT UP AS SHOWN HERE

Shop Shortcuts



For Making Long Jig-Saw Cuts

WHEN it is necessary to make a cut on the jig-saw that is too long for the throat of the saw, the blade should be replaced with one twisted as shown. To twist the blade, heat it red hot.

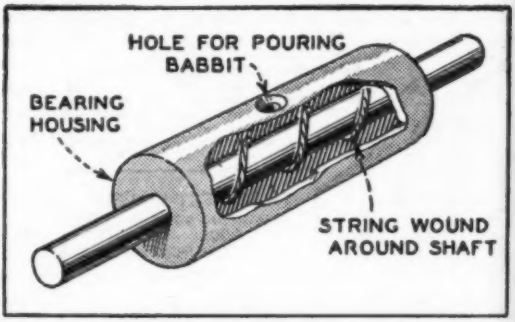


Two-Blade Work With A Hacksaw

BY MAKING two strap metal holders for the blade retaining pins as shown, it is possible to use two blades in one hacksaw frame on slotting jobs. Pin holders keep blades in tension.

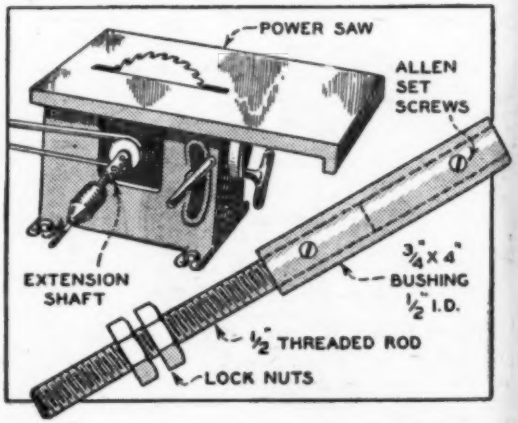
Oil Grooves For Bearings

WHEN casting babbit bearings it is a simple matter to cast the oil grooves in the metal, eliminating the necessity for tedious grooving later. Wrap a piece of string around the shaft being used during the casting process. This string should end just short of the ends of the bearing.



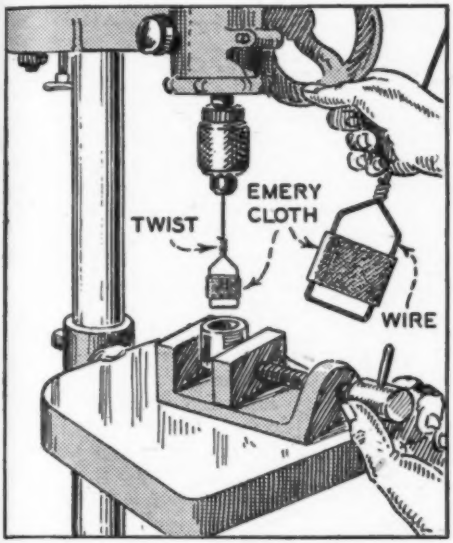
Extension Shaft On Saw

THE end of the shaft on a circular saw may be conveniently adapted to wide use by means of the extension illustrated below.



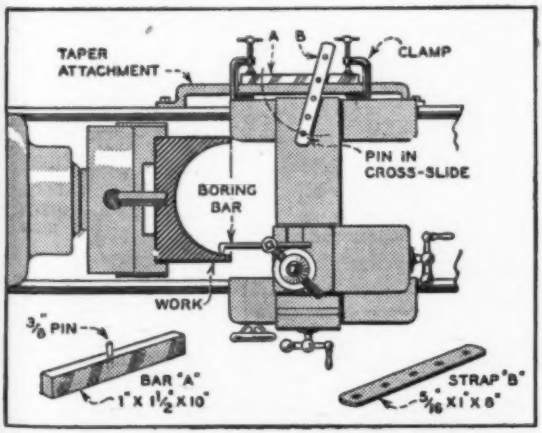
Wire Makes A Hone

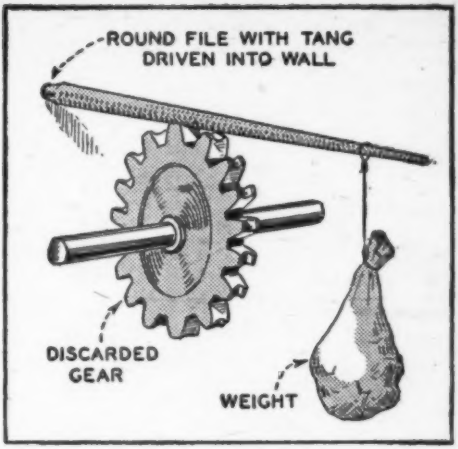
IF AN off-size job finds you without the proper hone, it's not difficult to make one from stiff wire and emery paper if the work is not too heavy. Shape the wire as shown and roll the emery paper around it, cementing the ends.



Spherical Lathe Work

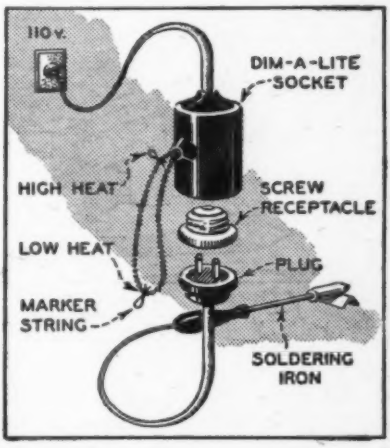
THIS rig makes spherical work on the lathe much simpler. Bar A carries an upright pin, and is clamped to the taper attachment at the back of the lathe bed. Radius holes may be drilled in strap B. Release cross feed. Strap pulls tool in a circle.





Pulleys From Gears

OLD gears such as automobile timing gears, can be quickly made into serviceable pulleys by turning them with power drill or lathe while round or V-file is held down on teeth as shown. Fiber gears are good.—*A. H. W.*



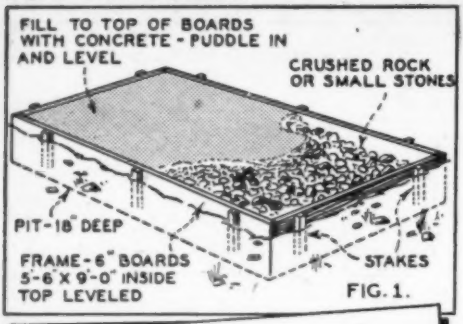
Regulator For Soldering Iron

THE familiar Dim-A-Lite socket is a simple and handy device when used to regulate the heat of a soldering iron that tends to overheat. Simply mark the pull chain for high and low heat.—*L. B. R.*

Backyard

Enjoy outdoor meals this summer with an inexpensive stone and brick fireplace.

by Edward F. Waldron
and Mae Foster Jay


FILL TO TOP OF BOARDS WITH CONCRETE - PUDDLE IN AND LEVEL
CRUSHED ROCK OR SMALL STONES
PIT-18" DEEP
FRAME-6" BOARDS 5'-6" X 9'-0" INSIDE TOP LEVELED
STAKES
FIG. 1.

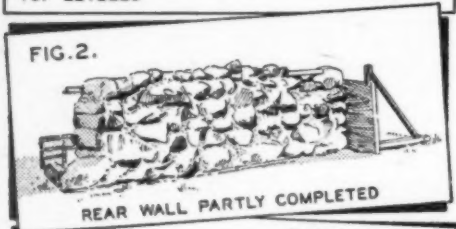


FIG. 2.
REAR WALL PARTLY COMPLETED

IN THIS day of outdoor fireplaces, there are many designs and varieties, some specialized for certain locations, and others of a more general type, suitable for almost any background or surroundings. Such are the two fireplaces to be described in this article. The big one, with which we shall start, has the hot plate at a convenient working height, and includes an incinerator and storage space for extra fuel. It is constructed largely of stones, and a few days of collecting work will round up enough material for the job in almost any locality.

The first step in building this fireplace is to dig a pit for the foundation. This pit should be 18" deep and measure 9' long by 5' 6"

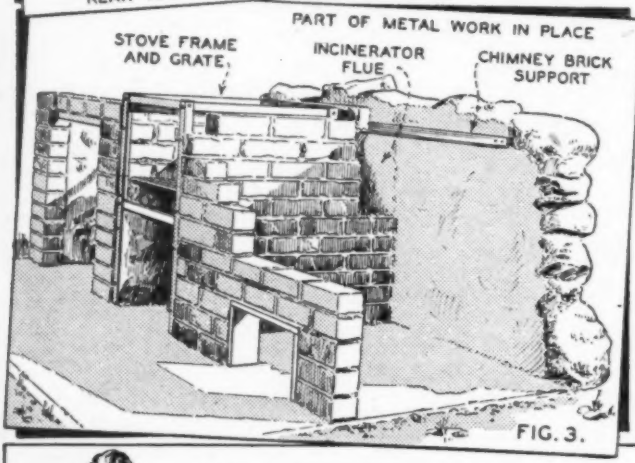
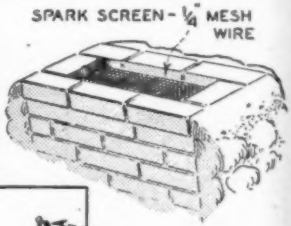


FIG. 3.



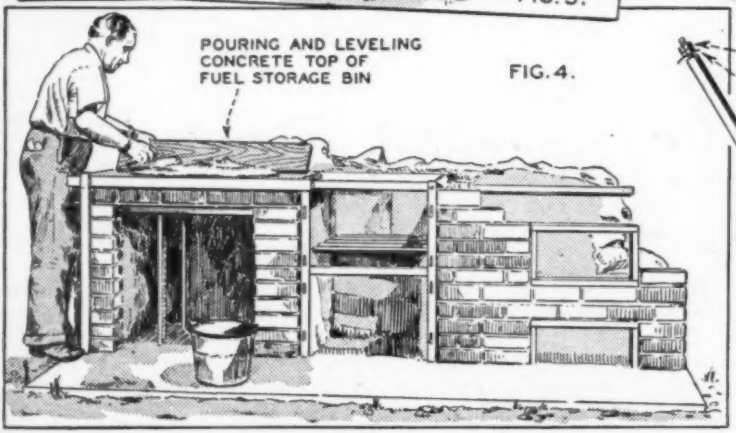
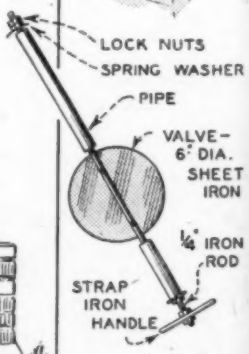


FIG. 4.



DAMPER DETAIL

Barbecue Kitchens

across. Fill it almost to the ground level with small, broken stones. Next, set up a form of 6" planks around the edges of the pit, as shown in Figure 1. A concrete mixture of one part cement to five parts sand is poured on top of the crushed rock and smoothed out in the form. Allow this concrete to set for four or five days (longer in damp weather), after which work on the actual fireplace may be started.

Make a form 7' long and 30" high that will stand upright at right angles to the cement platform. This should rest on the platform exactly 12" in from the edge and be anchored in place with large stones to keep it steady. (Figure 2.)

Next comes the task of laying up the stones for the rear wall against the platform. Use "Brixment" mortar between the stones. Put down a trowel or two full of mortar, then a large stone, then more mortar, followed by another stone, etc. After the first row has been laid, a second is started on top of the first, coming sharply out to the corners. Use plenty of mortar, filling the chinks with smaller stones and mortar, so there will be no air holes in the wall. Mortar should be thrown against the form to give the inside a smooth coat.

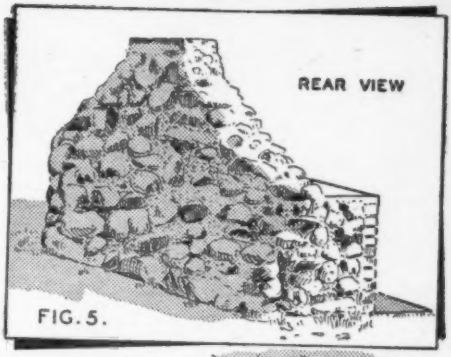
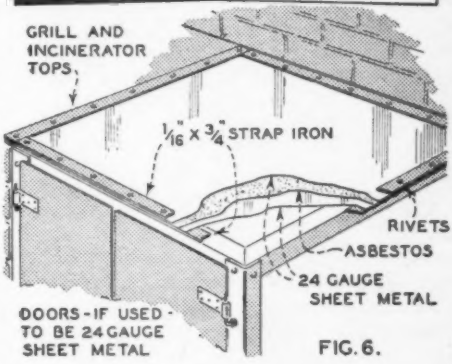


FIG. 5.


GRILL AND INCINERATOR TOPS
1/16" X 3/4" STRAP IRON
RIVETS
ASBESTOS
24 GAUGE SHEET METAL
DOORS - IF USED - TO BE 24 GAUGE SHEET METAL
FIG. 6.

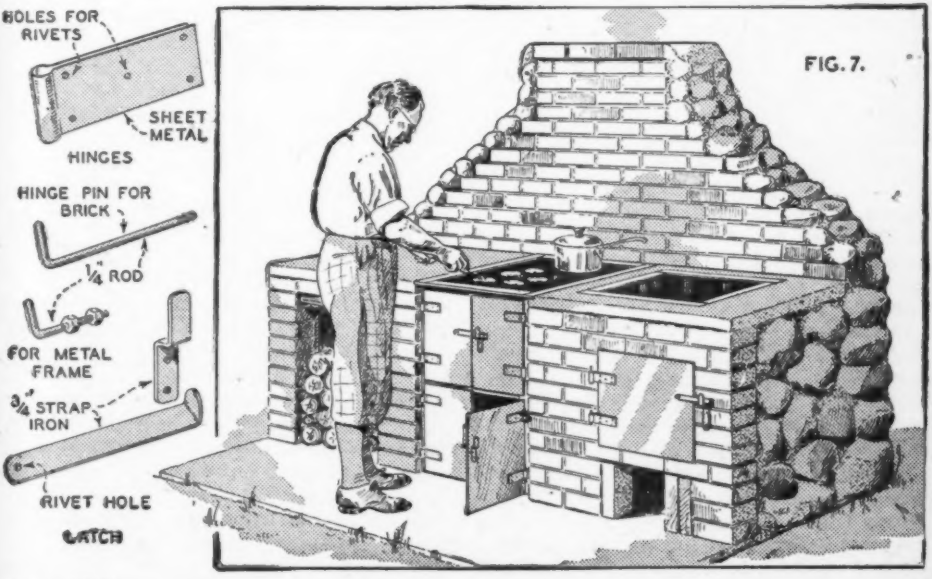
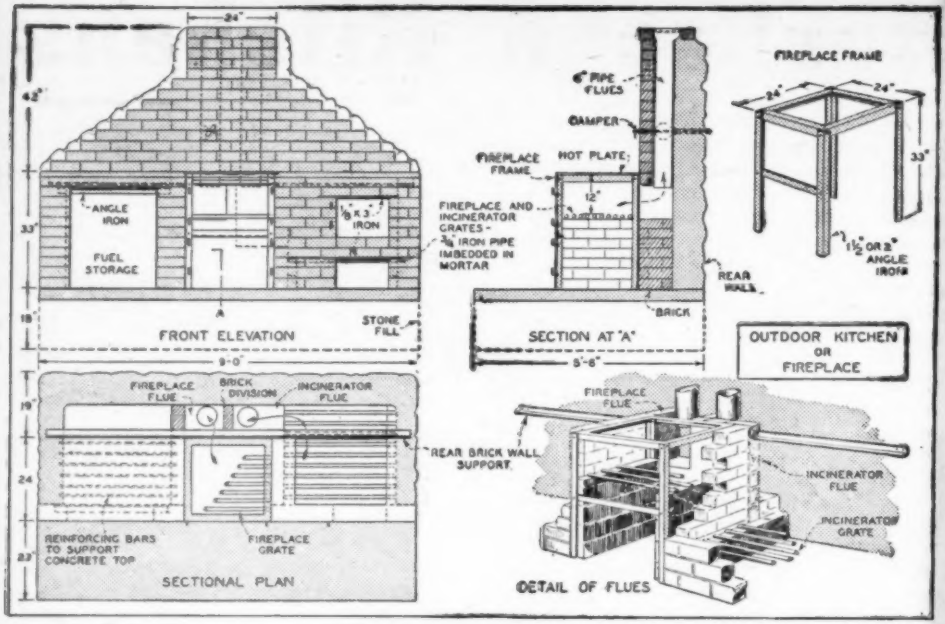


FIG. 7.



When the wall has been completed to a height of 30", the brick work on the fireplace should be commenced. Remove the form, and measuring 7" in from the wall, make a chalk mark the whole length of the concrete base. Draw a perpendicular to this line 3½' from each end. Two feet from the line, parallel to the wall, another parallel line should be drawn, also the length of the platform. You have now laid in the front line of the fireplace and the sides of the firebox. In the center and against the wall, build up a brick pier 2' long, 7" deep and 12" high. Figure 3 shows the partially completed structure.

The frame for the fireplace proper is made of angle irons, as in Figure 4, 6' 3" high by 2' square. In the original fireplace old bed rails furnished all the necessary angle iron, plus a small amount of material from a local scrap pile. One rivet in each end of each piece is all that is necessary, since the frame is built into the bricks. The frame is placed against the brick and at the top is 7" from the wall.

Next, a wall one brick thick is built up on each side of the frame, clear out to the front of the fireplace, where the bricks for the front are dove-tailed into the side walls, making a strong corner. Build right up to the underside of the top frame and back to the wall on the left side. On the right side, this wall goes only to the back of the frame and a divided partition is formed in the middle to make the two necessary flues. (See detail of flues.)

Under the grate position inside the walls, bricks are built up on edge as high as the grate. These bricks will anchor the frame in place as soon as the mortar sets.

The end walls, also of stone, are then built against the board form in the same manner as the back wall. (See Figure 5.) The stone ends must, of course, stop short of the actual width of the fireplace in order to allow for the front facing of bricks. (Figure 7.)

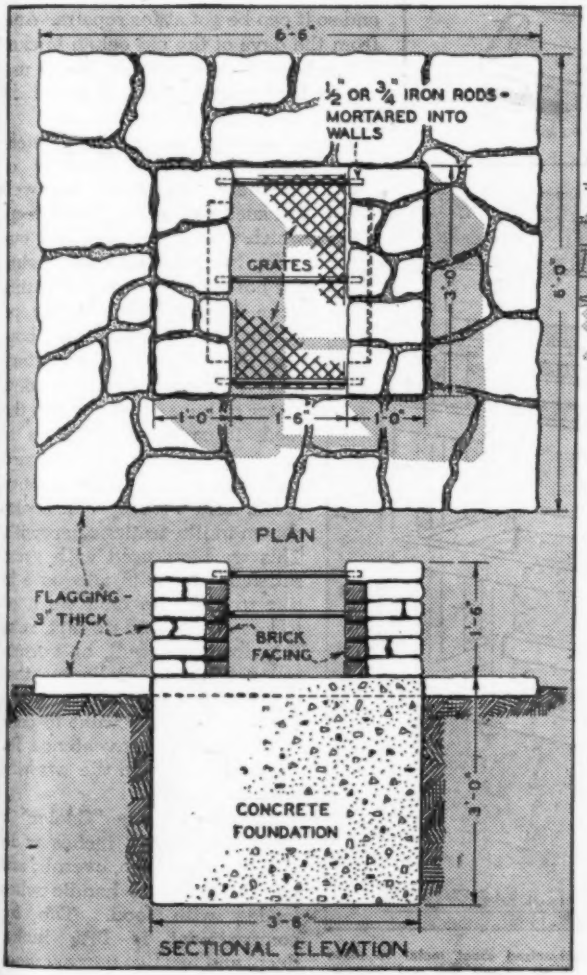
As the brick front of the fireplace is built up, door openings should be left as indicated in the plan. These openings are all topped with angle and strap iron strips which extend into the bricks on either side of the openings. The large opening on the left for fuel storage is closed across the top by means of a wood platform supported on posts *inside* the brick structure and the same height as the reinforcing angle iron across the top of the opening. The bricks, as you will notice, extend one row higher than the top of this opening. Several pieces of reinforcing bar iron, about ½" in diameter, are laid across the top openings (above the wood platform), with their ends resting on the brick walls, front, back and sides.

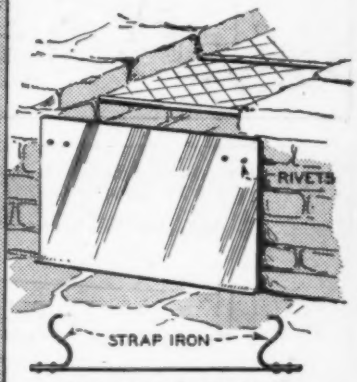
Build up the back brick wall until it is higher than the fireplace framework. You can now pour concrete into this top opening

and trowel it off level with the edges. This operation is shown in Figure 4.

The gratings for the fireplace and incinerator sections can now be laid. They are made of old ¾" pipe with the ends embedded in mortar. The whole inside of firebox, flue and incinerator should be plastered with a ½" coat of mortar to prevent the heat from disintegrating the brick and stone.

If doors are to be used, they should be made now and angle hooks in the fireplace frame and brick work inserted. These hooks are made from 6"x¼" bolts with the heads cut off and bent over 1½" from the unthreaded portion. Those through the iron frame have a nut inside and outside.





SHEET IRON DRAFT SHIELD

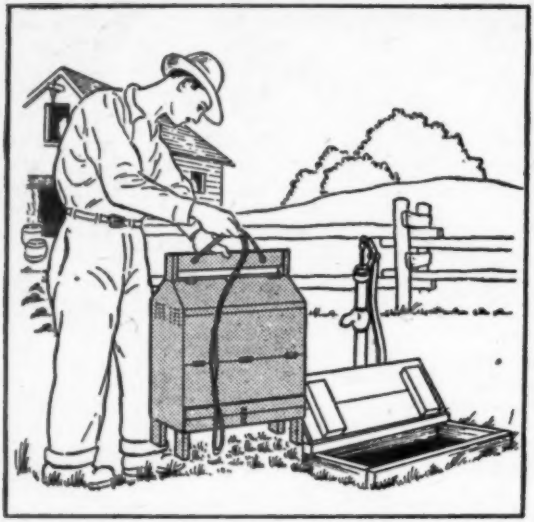
The doors can be made of 24 gauge galvanized or black iron. Hinges and fasteners are made from the same material and riveted on. (Figure 7.)

A top slab for the right side of the structure is then added in the same manner as was the left side. The back wall may now be built up some on each side, with the center left open. Procure three lengths of 6" stovepipe and a 6" damper. Cut one length in half and add each of these halves to the other full length pieces. A long handle must be made for the damper so that it will come through the front of the back wall and be within easy reach. This is

[*Continued on page 172*]

FARM

Outdoor Refrigerator



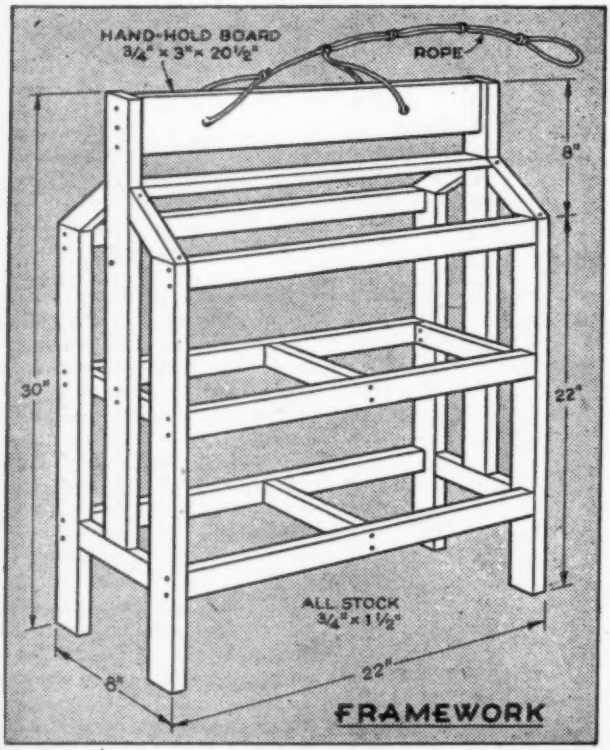
In the camp or on the farm you can keep your food in Nature's icebox.

AT MANY isolated country homes, summer camps and hunting lodges, where there is no cellar, it is often a trying problem to keep food cool in hot weather when the use of ice or modern electric refrigeration is not available.

But many of these places have a well with a deep curbed-up pit beneath the foot-platform to put the cylinder head down below frost line, and so it can be got at for repairs. And from the days of the old oaken bucket it has been a common practice to use the cool air space in wells to keep food cool.

At our summer camp near Chetek, Land of Lakes Country of Northern Wisconsin, the well has such a pit about 8 feet deep, which we used for keeping our milk, butter, etc., cool during the hot summer months; letting same down in a pail with rope attached, to the dirt floor bottom. But this was unsatisfactory and a great bother, as dirt, water or bugs often got into the food, in spite of attempts to keep pail covered. So I designed and built the waterproof, bugproof, and mouseproof cooler shown in illustrations herewith. This we have used with great satisfaction. It is adequate in size to hold the food we need to keep cool—and no dirt, rain, drip from the well, or vermin can get into it. Believing that many of my fellow outers and country folk may want to construct such a convenience for themselves, I give the working details herewith.

The size of my "Cooler" is 22 inches long, 8 inches wide, and 30 inches high, overall; and not too heavy to handle when loaded with food. The top compartment is 10¾ inches deep, and has two narrow wood



Framework of well-cooler is covered with galvanized sheet metal to make completed job shown at top. Size may be varied to suit well and purpose.

For Wells by Edward Moore

braces across, 6 inches from left end, forming a partition to keep milk and ketchup bottles, etc., from tipping over. We usually put the milk, butter, eggs, salads, etc., in the top, and such foods as meat, vegetables, fruit, etc., in bottom compartment. But the size to make your cooler will depend upon the diameter of the well-pit opening under the foot-platform of your well, and other factors of choice and necessity that you may have to contend with. If ladies are to handle the cooler, it might be well to make it about two inches narrower each way. This will make it a trifle lighter and easier to handle and lower into well-pit when laden with food. And by using light pine strips, ¾ inch thick, by 1½ inch wide for the frame, the weight can be kept down to the minimum.

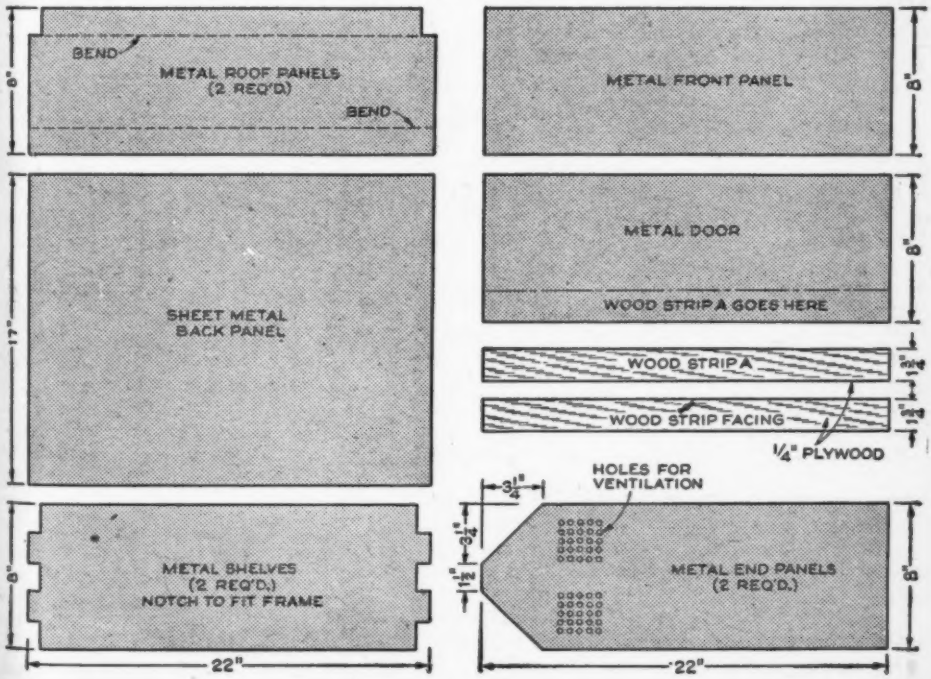
By giving the frame two coats of good white refrigerator paint (before putting on the metal side-walls) allowing plenty of time between each coat for enamel to dry hard so paint will not peel from moisture, the cooler will be more sanitary, and facilitate cleaning. To clean, simply scrub out with hot sudsy water and rinse well by dousing inside and out with pails of fresh water and lean cooler against tree or building with doors open to drain so sun can shine into it to dry and purify the inside. The short legs at bottom keep the cooler up off the damp ground or water in well-pit—and slant-roof top turns off any water drip from pump, or rain leaking through platform. A few small nail-holes in each end, as shown in drawings, serve as ventilation without letting in insects.

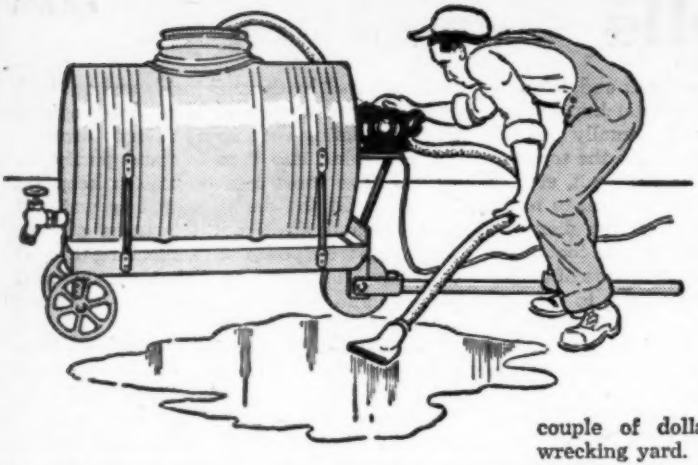
The metal side-walls are of medium weight galvanized iron—stiff enough to have "body"—but not too heavy. Your tinner will know what gauge is best suited to your purpose—and he will cut them out for you, at little or no extra cost, if you give him outside dimensions of panels—and you can do the necessary corner and end-notching where pieces fit around frame.

The first step in putting on the metal work is to measure, mark, and notch out the ends of the two metal strips to be used for the middle shelf and bottom piece, so they will

[*Continued on page* 176]

Cut sheet metal to sizes shown. Tinsmith can do it for you when metal is purchased. Notches are best cut by hand.





ELECTRIC FLOOR MOP

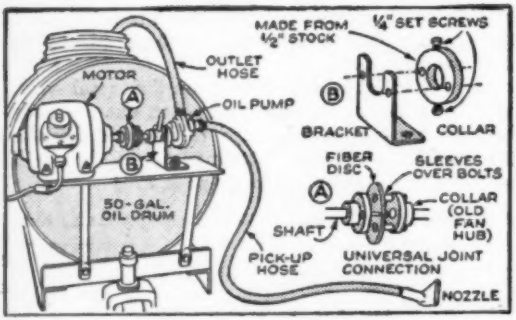
OPERATORS of garages, dairies, mills, and farms are often confronted with the problem of disposing of excess water in clogged sump drains, or low spots in the floor, or in the basement.

You can build a water pickup device out of scrap material picked up for a couple of dollars at an automotive wrecking yard. An old quarter horsepower motor will actuate the pump, providing the necessary suction.

On a small three-wheeled cart built so that it slants slightly to the rear, mount a 50-gallon oil drum. Cutting a hole in the top of the drum, weld in a small grease drum cut to fit the contour of the large drum. A spigot is fitted at the lower rear end of the drum.

The motor is mounted on a small

[*Continued on page 154*]



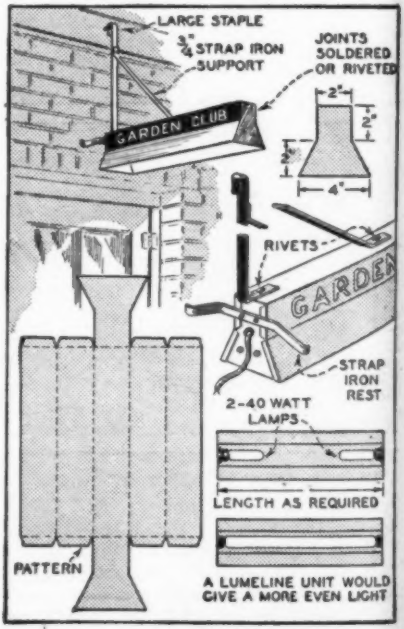
Miniature Marquee

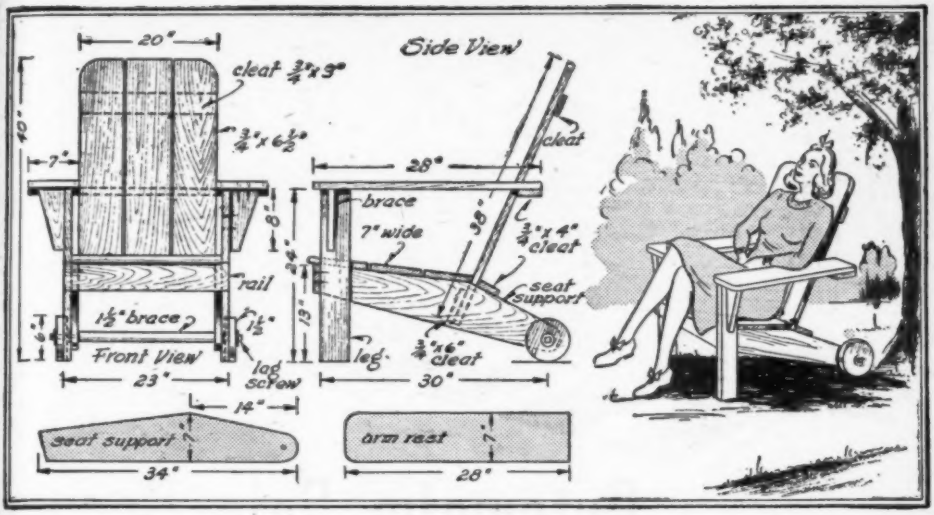
IF YOUR garden club or other organization has the use of a cellar in a private residence, the combination sign and entrance light shown will be found useful, particularly if the meetings occur but once or twice a month. It can be quickly hung up or removed as required.

The box can be made of a single piece of sheet metal or it can be built up from scrap strips. The length of the box will depend largely on the number of letters in the name selected. The name can be cut out on a scroll saw, remembering to do this before bending the box to shape. The name need not be on both sides, if the sign is approached from one direction only.

The support is made of ¾" strap iron and the length of the upright piece is governed by the make-up of the wall over the doorway. In this case, a large staple was driven into the clapboard and the support hung from it.

Paint the box before placing the lights, white on inside and any color that harmonizes with the surroundings on the outside.—*Frank Harth.*



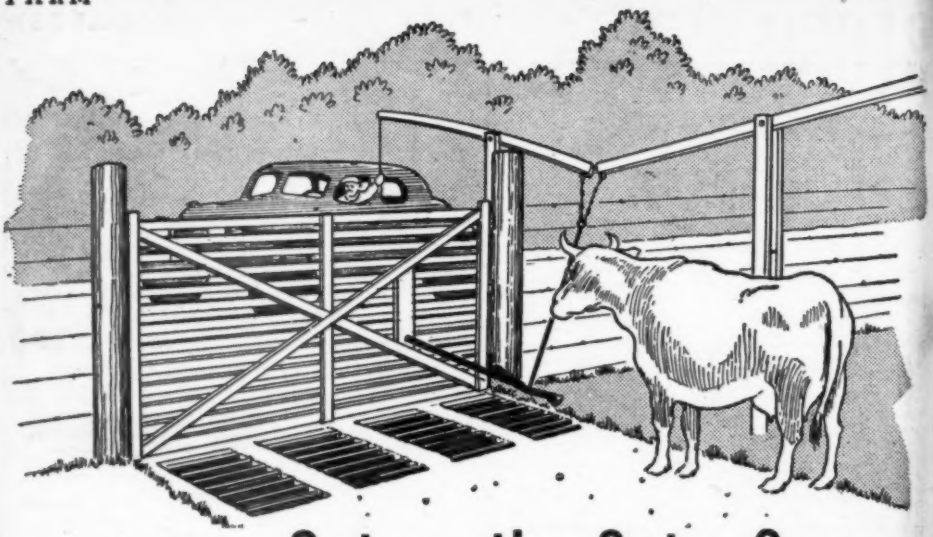


ROLLING LAWN CHAIR

YOU will need three boards, each 6½" wide and 38" long, for the back of this cool lawn chair. Each of the two arm rests are 7" wide and 28" long when finished. Note that the corners at the front end are rounded. The legs are two boards, each 24" long and from 4" to 5" wide. The two seat supports are cut from boards 7" by ¾". Note that one end of each board is rounded while the other end is sawed off at an angle, making the lower edge 1" shorter than the upper edge. The ends taper from a width of 4" to a width of 7" at a point 14" from the rounded end. Bore a ¼" hole in the rounded ends as shown. There are three seat boards, each 21½" long. The rail board, which is fastened to the front edge of the legs under the seat, measures 4" by 23". The two arm rest block supports are each 8" long, 4" wide at the top and 2" wide at the bottom. A cleat board, which braces the back ensd of the arm rest boards, is 4" wide and 34" long. Another cleat is fastened across the back of the chair at the upper end, and another to the seat supports just back of the back rest. The lower ends of the back rest boards are fastened together with a cleat 6" wide, as indicated by dotted lines. The boards used in the construction of the chair are all ¾" thick, with the exception of the wheels and axle or wheel brace, which are 1½" thick. With a compass draw a full-width circle on a two-by-six board, and saw it out. Bore a hole through the center of the wooden wheel slightly larger than the lag screw with which the wheel is held in position. From a two-by-two plane down a round brace 1½" thick and 20" long.

To assemble the chair, fasten the back rest boards together with the cleat near the top and across the bottom. The boards can be fastened with nails or screws, screws making a much sturdier job. If wood screws are used, start small holes for the screws with brace and bit to prevent splitting. Assemble the seat, fastening boards to supports. Slip metal washers between support boards and wooden wheels, and place washers between the outside of the wheel and the head of the lag screw. Turn the lag screws until they are fastened securely through the seat supports and ends of the brace, yet leaving a little play for the wheels so that they will turn freely. Fasten the front legs in place as shown and brace them with the rail board. Attach the arm rests in position, with the inner edge of each arm rest board against the sides of the back rest. Set the arm brace blocks in place as shown.

Paint the chair whatever color you may prefer. A set of two or three such chairs will make your lawn or shady spot in the back yard an ideal, cool place to relax.—*G. E. V. H.*



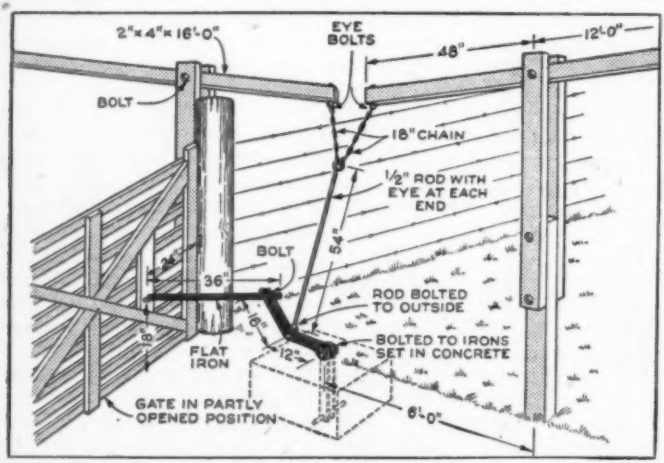
Automatic Gate Opener

Rainy nights no longer need be annoying to the driver—you open this gate from the car.

by Lawson Lee

EVER grumble to yourself when you had to get out of your car to open your gate? Here is a plan whereby you can easily construct a mechanism that will open or close your gate from either side without the necessity of getting out of your car. The accompanying drawing shows the gate as the driver of the car is about to open it.

Choose two pieces of strap iron 28" long. Twelve inches from one end bend both strips as shown in the drawing to slightly less than a 45 degree angle. Fasten the two strips together allowing about one inch of space between the two. Flare slightly on the 12" end and drill a hole in each one. This end is anchored by means of a bolt to two previously drilled pieces of iron set in concrete. The strips should be fastened in such a way that they swing easily on the axis. Six inches down from the top of the 16" end drill holes through both pieces.

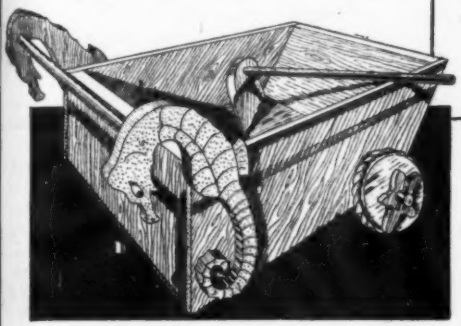


A 36" piece of flat iron is passed between the two strips and a bolt is passed through all three. The center piece should have a large hole so that it can "wobble" freely in all directions. The other end of the 36" iron is fastened to the gate by means of an eye bolt. Drill holes through both strips at the point of the angle and fasten a 54" eye rod on the outside by means of a

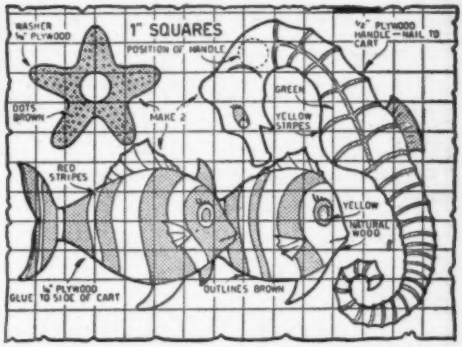
[*Continued on page* 154]

BEACH CARTS FOR KIDS

by R. L. Fairall



A couple of these colorful little carts, with the attractive fish decorations, will provide young children with many hours of delight on their seashore visits.



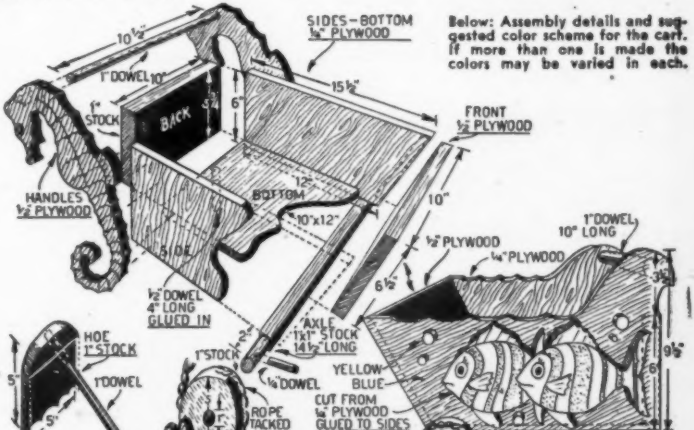
The marine life designs, to be scroll-sawed from plywood, are sketched above in squares for easy copying.

THE children will go for these wooden carts and hoe for play in the sand, in a big way.

To make the model with the sea-horse handles, draw the sea-horse on paper first; then black the back of the drawing with a soft lead pencil and trace two to ½" plywood and jigsaw them out. Cut the back section from 1" stock 10"x5¾"; the front section from ½" stock 10"x6½"; the bottom from ¼" plywood 10"x12", and nail these sections together as shown in the illustration.

Cut a length of 1" dowel or a piece of broom handle 10½" long and fasten it between the heads of the two sea-horses with screws. Make the axle from 1"x1" stock 14½" long. Round off two inches on each end for the wheels to revolve on. Nail this axle to the bottom, slip a wheel

[*Continued on page 152*]



Below: Assembly details and suggested color scheme for the cart. If more than one is made the colors may be varied in each.

THE SCHOOL SHOP

Conducted by Frank Petraglia,
Shop Instructor, Samuel Gompers Industrial High School
New York City

Craftsman Or Putterer?

THIS question is asked not to imply that you might belong to the latter class, but rather to illustrate a few points of difference between one and the other. For instance, do you feel a glow of satisfaction when the things you make are referred to as products of craftsmanship, and do you rise in indignation when they are regarded as mere "puttering"?

You can spot the putterer's work immediately. There is that about the putterer's working style which, once seen, is never forgotten, like strange shapes in a bad dream. This does not mean, however, that the craftsman, whose productions are notable for their style, is one who works in full dress. Indeed, no. You will find him in overalls, if anything. The workshop is certainly one place where clothes do not make the man.

Making things is, of course, in simplest terms, a "putting together" of one thing and another. But the craftsman does so with what is aptly termed a regard for their logical connection. Good workmanship, eye appeal, all-round good form—this is what characterizes the craftsmanlike job. The craftsman would no more think of marring a job with a "good enough" makeshift than you would wear red flannel underwear in summer weather. Poor workmanship is a thorn in his side.

Actually, there's a lot more to making things than merely putting them together. You know that old one about the cake: you can mix all the ingredients according to formula, but still there's no flavor—one thing which a good cake must certainly have. It's about the same when one mixes ingredients of wood or metal. There's a touch of science in a well-calculated and planned piece of work, and perhaps a touch of art, too. At least, that's what the good books and good cooks say. That something which has been added, we all recognize as style. Good work has style; just like good cake, it always yields a definite flavor.

However, don't be deceived into thinking that your work is a failure because it doesn't taste good. The rarest Chippendale masterpiece is tough on the stomach regardless of what corner of that marvelously fine furniture you chew. Adding French polish won't help either; it will just stick all the more. No, style cannot be eaten, but it can be seen. Like flavor to the stomach, style brings delight to the eye.

That is all we wanted to say this month. You draw your own moral.

STUDENTS' PROBLEM BOX

1. Q.—How are dry cells connected together so that their voltages will add?

   A.—Cells must be connected in "series" to make the voltages additive. The series connection is made by connecting the negative terminals to the positive terminals.

2. Q.—What improvement may be made on a vise to make it hold round stock without slipping?

   A.—A small flat V notch filed in each jaw of the vise will permit round stock to be held securely without slipping sideways.

3. Q.—I have been told that in the early days of marine radio another distress signal was used in place of the present "SOS." What was that signal?

   A.—The early distress call was "CQD" which was an abbreviation of "Come Quick Danger."

4. Q.—Could you tell me what Britannia metal is?

   A.—This is the trade name for a good grade of pewter, an alloy 92% tin, 6% antimony and 2% copper.

5. Q.—I am interested in taking up metal craft as a hobby. Please refer me to a good book or two on that subject.

   A.—Art Metal Work, by E. F. Kronquist (Whittlesey House) is excellent. So is Metal Spinning, by Reagan & Smith (Bruce Publishing Co.).

6. Q.—What is a good method for cleaning a dirty commutator?

   A.—Hold fine sandpaper against it while it is running. If it won't run spin it by hand or place in lathe.

7. Q.—Is there some "kink" which may be used to facilitate the sawing of plywood so that a clean cut can be made?

   A.—Before sawing, score one side of the plywood with a sharp pocket knife, making a fairly deep cut. This knife-cut side should then be on the under side during the sawing so that the teeth of the saw will cut through the knife cut where the wood fibres have been separated. This makes a neat cut possible. Use a fine-tooth saw.

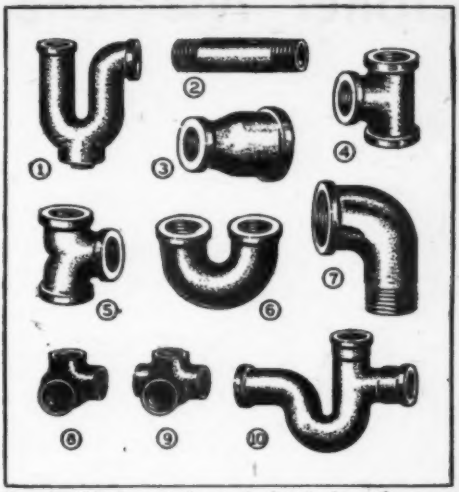
THE SCHOOL SHOP NEEDS REPORTERS

If you would like to be a reporter for your shop group or school, just indicate this briefly on a postcard. Address MECHANIX ILLUSTRATED, 1501 Broadway, New York, N. Y.

Flashes From School Reporter

The "SS" reportorial staff has reached the 100 mark! Just who is the one-hundredth reporter to be inducted is hard to say because the mail-man brought these new entrants in at about the same time: Jerome Rosenblum, Tilden H. S., Brooklyn, N. Y.; Nathan Bogoch, St. John's Tech. H. S., Winnipeg, Canada; Arthur A. Newman, Oneida Co. H. S., Walter Priggin, Napa Union H. S., Napa, Calif.; George Calterra, Oswego H. S., Oswego, N. Y. With a staff this size, the SS is now on a level with big metropolitan newspapers...News of the great doings in the school shops' model building program has been getting front page notices in all the leading papers. We wonder how many of our SS members have participated in this undertaking? We hear, too, that most production quotas of planes have been completed by the schools. Now that the boys are in working trim they are getting ready for the next big production order from Washington . . . The Canadian school shops have been pretty well organized along these lines, too . . . Nathan Bogoch, of St. John's H. S., in Winnipeg, tells of still more extensive participation among pupils there in the government program. In addition to wood and metal planes, the electrical classes are producing various electrical and radio equipment and devices. . . . Yes, the Spring Term is certainly winding up with a bang. The great out-of-doors beckons. . . . Just a few weeks now, when the hurdle of final exams is overtaken, we'll be saying goodbye for awhile to the school shop and getting around to building all manners and conditions of things on the long summer days. . . . 73s.

HOW MANY OF THESE PLUMBING FITTINGS CAN YOU IDENTIFY?



You shouldn't have to be a plumber to know the names of the common pipe fittings shown in this month's Craft Test—though we'll admit it would help. Score 10 points for each correct answer and check your score on page 176.

Selecting Colors For Painting

In selecting a paint color from a small sample card, remember that it will look darker when it is applied to a whole wall or other large painted area. In testing paint on the surface to be painted, cover a foot or two rather than just a small space in order to get a better idea of the way it will look.

MI SHOP SCRAPBOOK INFORMATION SHEET

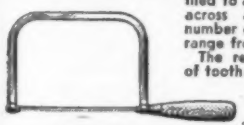
SAWS

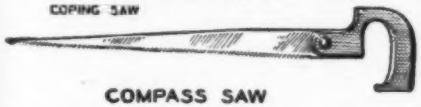
AS WITH other common tools, there are a variety of saws, each serving a specific purpose. The most often used are the familiar *ripsaw* and the *crosscut saw*, each of which may be identified by its teeth.

The teeth of a ripsaw are of various sizes, depending upon the fineness of the work to be done. These sizes are indicated by "points" per inch, or the number of teeth in 1" less one, and the number of teeth a saw contains is stamped on the blade. For example, a 5 point saw has 5 tooth points, but only 4 complete teeth in 1" which are shaped like chisel points.

Similar in shape and appearance to the ripsaw, the crosscut saw differs in the shape of its teeth, which are filed to a point instead of square across as on a ripsaw. The number of points to the inch will range from 8 to 12.

The reason for this difference of tooth shapes is apparent when their particular uses are considered. The ripsaw is used for cutting *with the grain* along a straight line. The ripsaw will cut through the wood fibres smoothly, as these fibres run lengthwise, and the ripsaw cuts them apart easily. However, when it comes to cutting across wood the wood fibres can only be torn apart with the sharp knife-like points of the crosscut saw.



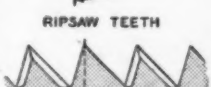


Among other common saws are the *backsaw*, which is a crosscut saw with a thin blade and fine teeth. To prevent buckling, a heavy piece of steel is fitted over the back of the thin blade. The backsaw is generally used for fine work.

The *compass saw* is shaped like a ripsaw, but its blade is narrow so that it can cut on curved lines.

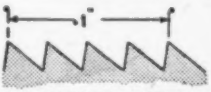
A *keyhole saw* is a smaller and finer compass saw.

RIPSAW TEETH



CROSS-CUT TEETH

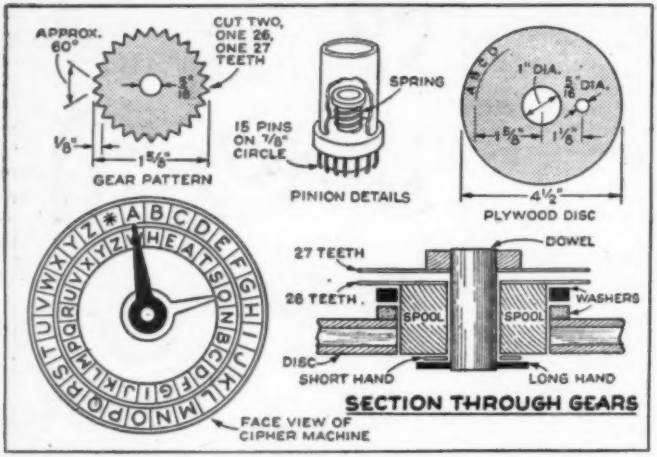
5 POINTS TO ONE INCH



4 COMPLETE TEETH

The *coping* saw is a very small saw fitted to a metal frame. It is used for sawing out fretwork patterns.

Cipher Machine Guards Secrets



The hands of the cipher machine turn similarly to those of a clock, one faster than the other. Cross section above shows gear arrangement that accomplishes this. Copy face as indicated or make up another code by using a different word.

by
Milton Van Dyke

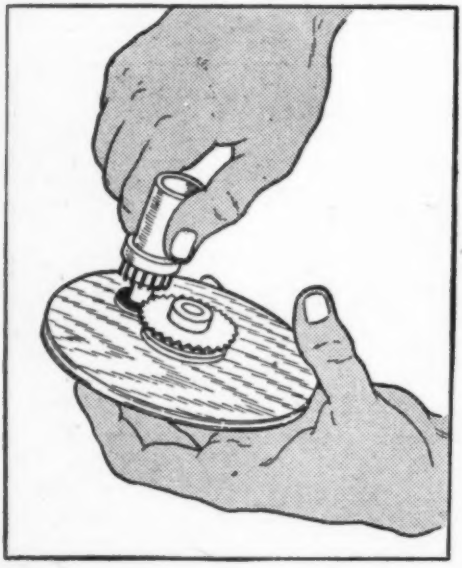
THIS cipher device, originated by the inventor of the Wheatstone bridge, will encipher messages so securely that only a skilled government cryptanalyst could read them. It is similar to a clock with a dial for each hand, and gears which move the "minute" hand slightly faster than the "hour" hand.

Cut a 4½" plywood disk for the base with a 1" hole in its center, and drill a $\frac{5}{16}$" hole to glue in the dowel on which the pinion turns. Paint the face white, letter the 26 letters of the alphabet and an asterisk around its circumference, and varnish.

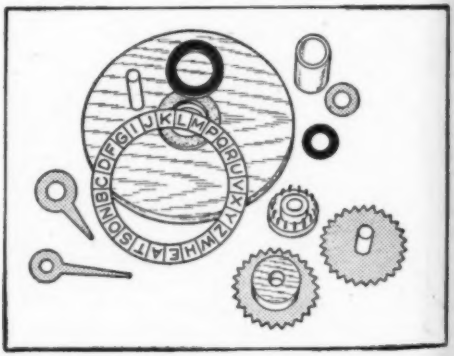
The two gears are cut from a tin can. The one having 27 teeth is cemented to a section of spool 1" in diameter, which turns in the plywood disk, and through its center passes a dowel to which the 26-tooth gear is fastened by means of a short piece of spool.

Two large washers cut from ⅛" fiber raise both gears from the body. After assembly the 1½" hand is attached to the spool, and the 2¾" pointer to the dowel. Both hands should turn freely against each other and the body.

[*Continued on page* 170]



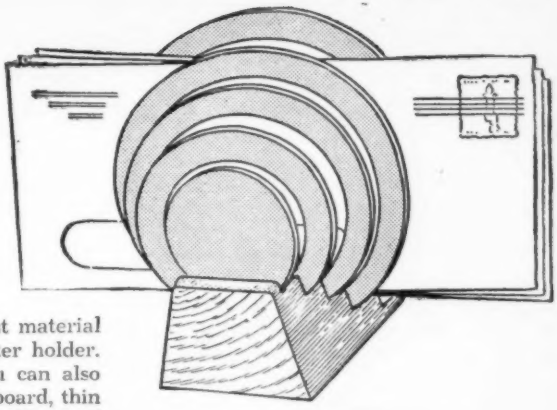
Pinion is raised by the turning knob to set the hands.



Right: Here are the various parts used in the cipher machine.

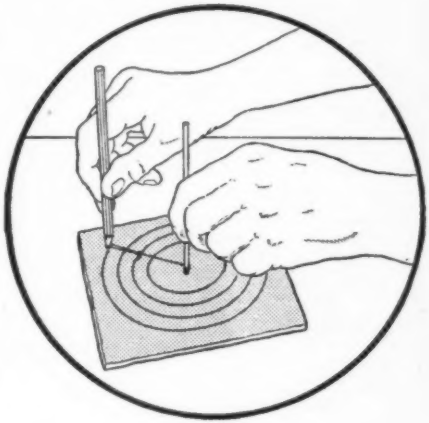
Spiral Letter Holder

by Benjamin Nielsen

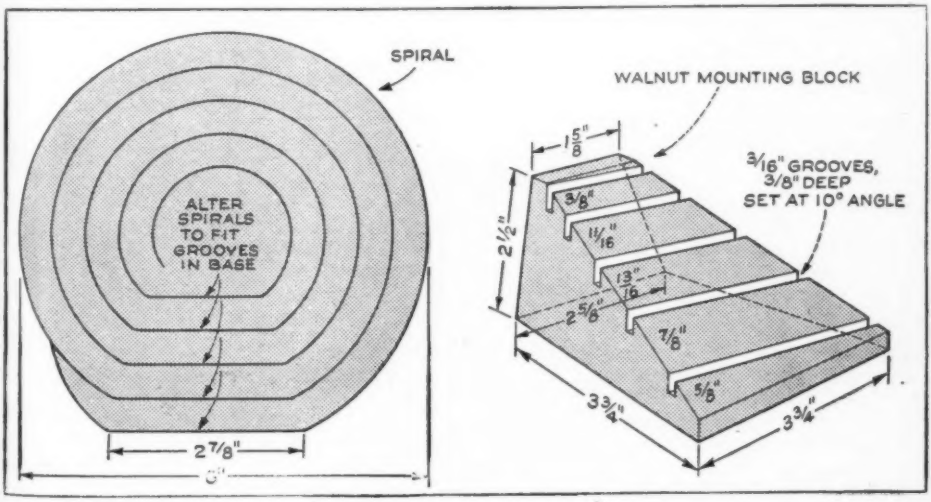


STIFF sole leather supplies the best material for the spiral of this unusual letter holder. While leather is the first choice, you can also use other things such as composition board, thin plywood or even sheet metal. The holder will accommodate a considerable amount of mail and help to keep the top of your desk neat.

Start by marking off the spiral on a six-inch square of whatever material you have selected. Drawing in circle shows method. The spiral is next altered by flattening one side of each curve, as indicated below. Next, cut along the lines with scroll saw or bandsaw. Smooth all the edges carefully, and if leather has been used apply paste shoe polish all over with the exception of the flattened bottom edges. Rub with a soft cloth to a high lustre. Plywood or composition board may be enameled or varnished, and metal can be buffed to a high lustre and given a coat of clear lacquer.



Insert the spiral in a mounting, or base block made of walnut to the specifications given below.



Play Bombsight

[*Continued from page* 111]

Twelve "ships" are also needed. These are shaped as shown in Fig. 2 and may be made of thin plywood or of cardboard. The ships are numbered as follows: Three of them are numbered 1, three of them are numbered 2, three of them are numbered 3 and the remaining three are numbered 4.

The final equipment needed are four legs to support the game board. These are each 10" long and fit into sockets in the under side of the frame. The same kind of dowel stick that supports the bombsight can be used. About ⅝" thick is a good size. These legs, when the game is to be packed, go into the box with the other parts. Thus the game is not only self-contained when closed, but is its own table when set up for play.

The game can be played by two, three or four players. If four play, two can be partners against the opposing two.

Each player's object is to move his ships from the home port to the port of destination despite the bombing of his opponents, while at the same time he attempts to bomb their ships. The ports are the white spaces marked A, B, C, and D. Each player's port of destination is the port directly opposite his home port. If four play, two against two, the port of destination is also the partner's home port.

FOR DEFENSE

SAVE THIS MAGAZINE!

Here's a simple way in which you can help your country's war effort.

When you are through reading this magazine, put it aside and save it. Do the same with any other magazines and newspapers you buy.

Magazine paper is an important source of wood fibre, which the government now needs in great quantities to make containers for shells, airplane parts, etc.

Your local junk dealer will buy your accumulation of old magazines and papers at an established rate. Phone him when you have more than a hundred pounds.

The American Red Cross, the Salvation Army or the Boy Scouts will take any sizeable amount of paper off your hands and see that it is put to use in defense.

Do your bit in this easy, but important, way. Save your magazines!

Rules and Method of Play

Player No. 1 places his three ships (all numbered 1) in Port A, player No. 2 places his in B, player No. 3 in C and 4 in D.

The players then take turns in "bombing" the two targets on the board for the purpose of determining which side shall have first move. It does not matter in what order the players bomb the targets. The method of bombing is to hold the ring to which the bomb (lead sinker) is attached between thumb and forefinger and lower it through the bombsight. Then swing over the target and at the right moment let go of the ring. If the player's aim is good the needle will penetrate the target. The game has an aspect of realism in that a bombing plane cannot descend too low for fear of anti-aircraft fire; nor can the player bring his hand low, for the bombsight prevents. Also, no plane can halt in the air over a target and drop its bombs. It must bomb while in motion, of course, and in this game the player (unless a ship is directly below the bombsight) is compelled to drop his bomb while the weight is swinging.

Each player has two shots at each target. If two players are teamed against an opposing two, the side with the highest aggregate score has first move in the game; and as between two partners, the man with the higher individual score goes first. In the event of a tie, the two high men play it off.

Assume that players 2 and 4 are partners against 1 and 3, and that player 2 has first move. He places one of his ships (one of the number 2's) in one of the six lanes leading out from Port B. The lanes are the paths marked off in black and white spaces. There are twelve lanes. Eight of them run across the center of the board and four of them run around the board parallel to the edges.

After the first player has placed one of his ships in the lane of his selection, the first player on the opposing side places one of his ships in the first space of one of the lanes leading out of his port. This procedure is followed until all twelve ships are placed, one to a lane. A player cannot place a ship in a lane already chosen by his partner.

Once in a lane a ship cannot move to another lane.

The journey from home port to port of destination can be made in only ten moves if made on one of the center lanes, while nineteen moves are

[*Continued on page* 149]

Play Bombsight

[*Continued from page 148*]

needed if the ship sails on one of the outer lanes. The long route is the safer, while the quick route is more dangerous in that the ships must pass beneath the bombsight. As will shortly be explained, players have a choice of routes as the game progresses. It might be thought that a ship passing directly under the bombsight is doomed, but in practice the swinging lead prevents a sure hit from being a foregone conclusion.

After the ships are all placed in the first spaces of their respective lanes, the player who won first chance gets the first opportunity to bomb the opponents' ships, and the other players follow in order. Each player, as his turn comes, gets three chances with the bomb, which is handled in the same manner as explained when shooting at the target.

If a bomb makes a direct hit on a ship (that is, if the needle transfixes a ship), that ship is regarded as sunk and is taken out of play.

If the needle lands in one of the spaces containing a ship but without touching the ship itself, the hit is regarded as having been sufficiently close to damage the ship and it must turn about and return in the same lane, space by space, to the home port for repairs. Having reached the home port it must remain there for one move and is then regarded as "seaworthy" once more and may start out again in any one of the six lanes leading from its home port, provided that the lane does not already contain a ship moving in the opposite direction. Thus a player may come to have more than one of his own or his partner's ships in one lane, all moving in the same direction.

The best lane for a repaired ship to choose is a matter for consultation if a player has a partner, or for individual decision if he is alone. The factors governing the choice are the relative merits of the short, dangerous route or the longer, safer route, the players, at this stage of the game, having had opportunity to gauge the bombing accuracy of their opponents.

After each player has had his turn with the bomb, all the ships that survive are moved forward one space and another round of bombing takes place. But a player with only two ships remaining in play gets only two chances with the bomb, and a player with only one ship gets but one chance.

A ship in port for repairs is still in the game and entitles its owner to one shot with the bomb. Such ships are also still subject to bombing by the opponents, just as are the ships out in the lanes.

If a bomb accidentally hits one of a player's own ships or one of his partner's the hit is acted upon as if an enemy had made it and the ship is taken out of the game.

If the bomb lands in the same space with a player's own ship or in a space occupied by one of his partner's ships, the ship must return to home port for repairs, just as if it had been damaged by the enemy. This would be true in actual war.

The winning side (or the winning player if two or three are playing) is the side that clears the board of enemy ships while one or more of its own still survive, or which succeeds in getting into home ports all of its surviving ships which must at least equal in number the number of enemy ships still in play. In figuring how many ships remain in play, ships that are in port for repairs and ships that have finally reached home port safely are included in the count. In order to avoid confusion in distinguishing between ships in port for repairs and soon to start out again, and ships safely home to remain there, turn the latter number side down. *All* ships in port are still subject to enemy bombing, and each ship in port still entitles its owner to one shot with the bomb as his turn comes around.

If one side succeeds in getting all of its surviving ships safely into home ports, that side has not yet won if its opponents have in play a greater number of ships. The winning side is still to be determined by continued play. Example: Let us assume that 2 and 4, who are partners have brought two ships safely into port, but have had all their others bombed out of play. Their opponents (1 and 3) have only gotten one ship into port and have two more out in the lanes. Play continues until one of three things happens. Either 1 and 2 get another ship into port, in which case they win, having as many ships in port as their opponents have in play, plus one in the lanes; or they might bomb out one of the ships that 2 and 4 have in port, in which case also they would win. The third possibility is that 2 and 4 might bomb any one of 1 and 2's ships, in which case 2 and 4 would win.

Close and exciting finishes are frequent.

Photoflash Lamps Of Plastic

Photoflash lamps in envelopes of transparent plastic, instead of the usual glass bulbs, are the subject of two patents, Nos. 2,277,481, and 2,277,482, issued to a Hungarian inventor, Michael J. Neumann de Margitta of Budapest, who has assigned rights in this country to the Westinghouse Electric and Manufacturing Company. In the second of his patents, the inventor departs from the customary shape and makes his flash lamp square, about the size and shape of a two-cracker sandwich, for greater convenience in carrying.

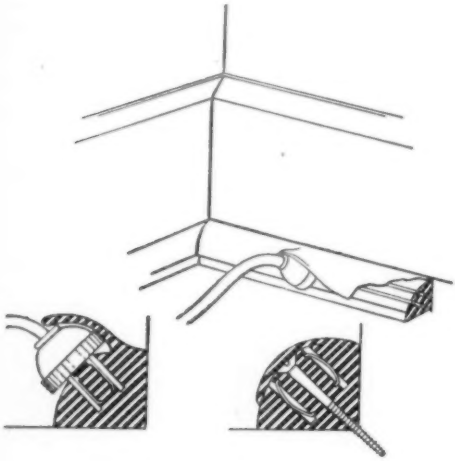
Among the advantages claimed for the new photoflash lamps are immunity to breakage when a lot of them are dumped loosely together and given rough carriage, and impossibility of exploding as glass flash lamps sometimes do. The latter property is obtained by choosing a plastic with a relatively low melting point.

New Products And Inventions

[*Continued from page* 11]

Trucks, buses and other heavy vehicles with diesel-electric or gas-electric drive can have their motors mounted directly in their wheels by the invention on which patent 2,273,840 was given to Otto E. Dever, Huntington Park, Calif. In a wheel of this type, armature coils would be fixed and stationary on the inner section, while the field coils, fastened to the rim of the wheel, would carry it around as they were pulled by the force acting between armature and field. Each wheel would thus be in effect a low-speed motor.

* * *



A continuous electrical outlet which will provide an available outlet connection convenient to any part of a room was recently awarded a patent. The outlet is in the form of continuous molding which takes the place of the quarter-round strip that is usually used at the corner of a wall and the floor. The body of the outlet is formed of a flexible, yielding insulating material, such as rubber, and may be inexpensively made in any desired length. A pair of parallel slots provided with contact strips are used to receive the plug connector. An important feature of the invention is the provision of an overhanging lip for closing the slots to prevent the unintended insertion of other articles into the slots. The lip also protects the slots against dirt and moisture. Thus, while the lip can be lifted for insertion of a connector, at no time are the open faces of the slots entirely exposed. (No. 2,267,610.)

* * *

Enriched beer may be expected presently to be adding its appeal for public acceptance to that of enriched bread. A method for restoring the natural yeast vitamins to beer, from which they are lost in modern clarification processes, is covered by patent 2,273,853, issued to Albert M. Fischer of Chicago, and assigned by him to the Rotary Extractor Corporation of Long Island City.

Beer brewed by old-fashioned methods is rich in vitamins, which are contained mainly in the yeast cells which remain in the beverage, Mr. Fischer explains. To get the very clear fluid demanded by present-day beer trade, these are filtered out, and most of the vitamins go with them.

In Mr. Fischer's process, a portion of the filtered-off yeast is first treated with a mixture of salt and sugar, which "draws" out part of their cell contents. Then the treated yeast is whirled in a centrifugal extractor, which separates the vitamin-containing liquids. These can then be restored to the beer, without damage to its clearness.

* * *

A simple military invention figures among the recent new patents. It is a device intended to reduce the recoil of rifles, virtually by making them lift themselves by the bootstraps. It consists in cutting openings in the last inch or two of the barrel, with sides sloping forward. As the bullet passes the inner ends of the holes, powder gases blow through them, giving the rifle a forward pull to offset the recoil.

Robert H. S. Hughes of Baltimore is the inventor; he has been awarded patent 2,274,239.

* * *

By storing liquid air fuel in hollow gyroscopes substantial saving in weight in space rockets can be secured, Prof. Robert H. Goddard, authority on rockets of Roswell, N. Mex., declares in new patents (Nos. 2,183,311-14) which have just been issued.

Prof. Goddard, who experiments in a remote New Mexico laboratory and is backed by funds of the Guggenheim Foundation, says that by using hollow rings on gyroscopes (used in controlling rocket flight) sizable amounts of liquid air could be stored without increasing the size of the rocket.

The weight of the fuel in the rings would give massiveness to the gyroscope and permit it, easily at first, to control the flight. As the fuel was gradually used up the mass and the amount of control would become less. But this would not be a handicap for much of the total weight of a rocket is in fuel anyway. The weight to be controlled would thus become less as the rocket went farther into space.

Prof. Goddard also describes a two-section rocket in which the tail part is slightly movable from within the rocket so that, by its motion, it could exert a definite controlling element on flight by the different actions of the exhaust gases upon it.

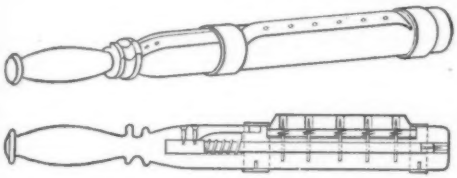
By a combination of associated rotating gyroscopes and a tiny pilot gyroscope, Prof. Goddard has devised a new and better way of controlling

rocket flight. Gyroscopes tend to retain an orientation in space as they spin and are so arranged, in the new patent, that they will produce a force on the rocket which will counteract some diverting, external force.

In his final patent Prof. Goddard describes a novel type of combustion chamber for rockets in which the liquid air fuel, being burned, is first passed through the hollow walls of the chamber and tends to keep the walls cool so that the terrific heat of combustion will not destroy them.

* * *

Anyone trying to grab a newly patented patrol stick from a policeman's hand is due for a sharp surprise. The novel billy is provided with a number of normally covered barbs that will be uncovered automatically due to pressure applied



to the stick by anyone grabbing the same. The barbs are retained in the club by a retractable sheath. During the time the patrol stick is employed as a defense weapon should anyone attempt to prevent use of the stick by grabbing the end, the sheath automatically moves so as to expose a number of closely situated sharp points. The points can also be released by means of a special lever on the club handle. (No. 2,266,606.)

* * *

An airship or dirigible balloon with a cylindrical metal tank running from nose to stern is the design on which G. J. Kimbel of Clinton, Ill., obtained patent 2,275,771. Mr. Kimbel's idea is to pump gas from the bag into this cylinder instead of valving, and thus losing it.

The cylinder, which acts more or less like the keel of a ship in stiffening the craft, also serves as support for the engine and propeller, which are mounted aft like a ship's propeller, instead of being suspended below the bag along with the cabin.

* * *

We are all used to the position of the wick inside the candle, burning down as the candle melts and supplies it with fuel. In a new and simplified device for producing the frost-averting smudge needed for the protection of orchards in spring, Wilfred D. Le Veille, Sr., of Dade City, Florida, reverses the usual relations and puts the "wick" outside.

His device, on which patent 2,276,220 has been issued, consists of a stout kraft paper bag with reinforced bottom. This is filled with fuel oil, and the edge of the bag ignited. As the oil burns the sides of the bag burn with it. The bag is made wider at the bottom than at the top, to insure against upsetting and spilling the oil.

* * *

An invention aiming at the use of an airplane's ailerons as auxiliary landing brakes is the subject of patent 2,275,692, granted to Edward Sims of Zanesville, Ohio. Ordinarily, the function of ailerons is to control the banking of a plane as it turns in flight, so that they are customarily connected in such a way that one turns up as its mate on the opposite wing-tip turns down. In Mr. Sims' invention, both may be turned either up or down simultaneously, to serve as landing brakes; in flight, they operate in the orthodox manner.

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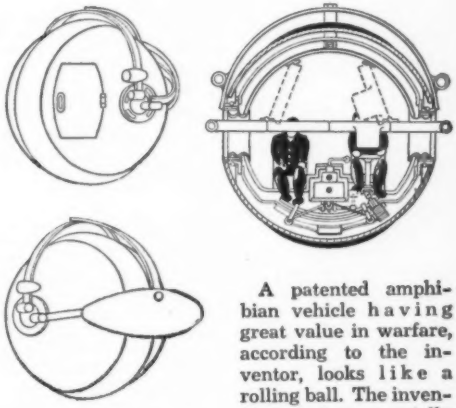


A patented amphibian vehicle having great value in warfare, according to the inventor, looks like a rolling ball. The invention consists essentially of a spherical, ball-like vehicle adapted to move by rolling on its circumference. An inner passenger sphere is mounted for level travel on anti-friction bearings which, in turn, are mounted in the revolving ball. The outer, or rolling sphere, moves forward on a huge outer rubber tire. Vision is obtained by transparent side windows and by means of side periscopes. However, with modern improvements in transparent plastics, the inventor looks forward to the time when the entire vehicle, including both the inner and outer spheres, will be made of a transparent material offering vision in all directions. Motor power is supplied by an internally situated engine, gasoline being fed from a tank which may be carried as a bustle outside the entire device. Steering is accomplished as on a bicycle by shifting weight. The inventor points out that the novel vehicle is valuable in warfare since the ball-like outer surface should provide for the maximum deflection of bullets, small projectiles, and the like. At the same time, the vehicle can roll across trench systems, barb wire, and through many areas now insuperable by tanks. (No. 2,267,254.)

The Black Easel

[*Continued from page* 94]

No. 4 enlarging paper. If, under these conditions, a piece of single weight paper is placed upon a white-surfaced easel and exposed, degraded tones will result from the "kick back" or reflection of rays that have passed through the paper by the white surface of the easel. The very deepest blacks of the print would not be affected, but various near-black areas would block up as a result of being struck from underneath by the reflected light rays and various lighter areas would reproduce somewhat darker, possibly to the point where highlight areas would be veiled.

Since the amount of light reflected by the white easel is not the same for all areas of the print, shortening of the exposure time will not suffice to correct the situation throughout. The only way to eliminate this objectionable phenomenon, which can obscure detail and distort tones, is to use a black easel which absorbs all light passing through the printing paper and striking it.

PHOTO FANS!

Don't miss "Dark Room Cabinet—On Casters" in the July issue of MI—on sale at your favorite newsstand June 1. Full construction details!

Professional photographers who process wash-off relief film or positives on film or glass are well aware of the destructive characteristics of white easels. They never use them. The transparent nature of these materials will definitely produce degraded results.

All this should not tempt you to condemn or discard your white surfaced easel. The white surface is convenient for focusing. *But always place a sheet of black paper under the enlarging paper before exposing.* The black paper wrapping of the enlarging paper is suitable for this purpose.

With black surfaced easels, on the other hand, a separate sheet of white paper is used for focusing, this being removed when the enlarging paper is placed in position for exposure.

The photograph at the bottom of page 94 illustrates the "kick back" effect of a white surface in a very graphic manner. A piece of torn white paper with black-letter printing was placed under the enlarging paper on a black-surfaced easel during the exposure. Considerable tone debasement is evident.

Generally, you may get by without the black underlay provision. At times, the cumulative factors involved in making an enlargement are such that penetration is impeded and the "kick back" is too weak or nonactinic to cause any trouble. The diffused type of enlarger; the denser negative; double weight paper, particularly buff paper; the soft contrast grades of paper—all tend to eliminate the halation effect. But, the degradation possibilities are always present when a white paper easel is used. Why take chances? It pays to use a black sheet underlay or a black-surfaced easel, at all times.

Incidentally, should you wish to coat a white-surfaced easel black, or recoat a worn black easel, the following formula will make a good black matte surface:

Wood alcohol	16 ozs.
Dry shellac (brown or red shellac will do)	2 ozs.
Lamp black	5 ozs.

These ingredients can be purchased from the common stock of any paint supplies store.

Dissolve the shellac thoroughly before adding the lamp black.

Apply with an ordinary soft flat paint brush.

Complete drying takes place in about two hours.

KEEP AWAY FROM OPEN FLAME.

Centerboard Hanger

[*Continued from page* 123]

drops down over the bolt, the board then being pivoted to the hole provided for it, the weight of the board being sufficient to hold the hanger down over the bolt, if it is the usual type made of oak, heavily driftbolted, or a metal one. To release the board a line is inserted through the hole in the top of the rod, the board being then shoved aft far enough to allow all to drop clear for floating or pulling out through the bottom of the slot. To put the board back in place the rod is lashed temporarily to the top corner of the board to hold it in place and the board floated in with the aid of ropes in the usual way. The temporary fastening is then removed and the upper end of the hanger permanently bolted to the top of the centerboard case.

The dimensions given will, of course, have to be altered to suit the particular installation. For salt water use the rod and all fittings can be sent away for galvanizing after being made up.

Beach Carts For Kids

[*Continued from page* 143]

(5" in diameter 1" stock) over each end; then a ¼" plywood washer cut as a starfish, and glue a ¼" dowel through the axle to keep the wheels on. Rope may be tacked on for decorative tires. Glue a ½" dowel in the bottom section at the back, as shown.

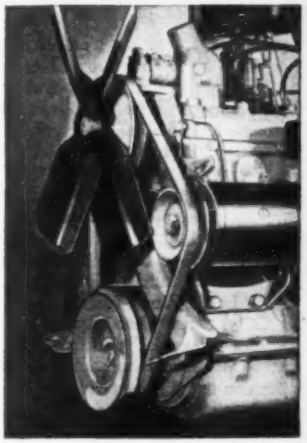
The cart with the plywood fish on the side is made similarly to the other except that the supports for the handle are a part of the side section and the handle is 10" long, and the wheels 3" in diameter, but all other dimensions are the same. Trace the fish to ½" plywood and glue them to the sides. Paint the carts with shiny enamel.

Saw the hoe from 1" stock. Round the corners at the top; scallop the bottom; drill a 1" hole through the top and glue in a 1" dowel handle. Plane or saw the hoe to a thin edge at the bottom or scalloped edge.

What's Your Car Trouble?

If you have a problem with your car, ask Mr. Russell. Just send stamped, self-addressed envelope for a personal reply.

by Frederick C. Russell



What would cause a fan belt to wear along the edges? B. S. N.

Either the fan or the generator pulley is out of line.

The bolt through the center of the transverse front spring sheared off because I did not keep the spring clips tight. Everything seems to be tight enough with the clips tightened. Is it all right to go along this way? C. B. T.

Definitely "no." The front end won't stay in alignment unless the bolt is replaced.

My engine uses too much oil. No leaks. No blow-by. Good rings. S. R.

How about leaky valve guides? They allow oil vapor to suck up from the valve compartment.

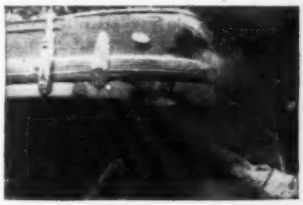
I am told that the strange steering of my car is due to a bent Pitman arm. What is this arm anyway? Car has not been in an accident. H. H. V.

The Pitman arm is a short connecting lever between the steering gear and the long steering drag link, as shown in the accompanying picture. There may be excessive wear in the connection at the bottom where these two arms meet. Note a grease nipple here. If the drag link or the Pitman arm is bent link will be out of line and cause "dive and dart."

What would cause the gas gauge needle to flicker constantly? S. B.

The contact points of the dash unit are dirty. Clean them by drawing a clean piece of bond paper between them.

There is some question about need for greasing the rear wheel bearings on my car. The greasing chart says this should be done but I can't find a grease nipple at either end of the rear axle. W. L. P.



Clean off the ends of the housing and you will find small plugs which should be screwed out. Grease nipples are then inserted for the greasing operation. This job is best done with the car on a lift or over a pit.

My car has developed a very serious low speed shimmy. Wheels have been checked for camber, caster and toe-in. R. C. H.

Check to see if the front wheel bearings are loose. Also have front wheels and tires balanced.

When cleaning spark plugs I found there was a lot of grayish tan powder on the nose of the insulator. Should I use a cooler plug? W. L.

Looks like these plugs are of the right heat type for the particular engine but that they haven't been cleaned for a long time.

Spot The Shadows!

[*Continued from page 55*]

forest resemble a fine textured sponge. The geometric patterns are cultivated fields of grain or orchards. By looking closer at the area (B), you can see that this area is crossed with rows of trees. Perhaps, after all, we're over California.

In contrast, note the plowed and harrowed field on the left side of the river.

Can you pick out a dirt road? What is that wiggling line through the trees at (B)? See how it disappears into the gulley, comes out again in its diagonal pattern through the orchard? It's a road, all right, a dirt road at that.

Study other sections of the map, and use your imagination in identifying fields, forests, roads and little hedge-lined freshets (I), for instance.

So you see that shadows are the real tattletellers of aerial photography. Mappers of vast areas use five-lens cameras, read these stories of the countryside as readily as you read this article.

Maps are made by piecing together subsequent pictures, overlapping the edges, matching on easily identified crossroads, peaks, bridges, farmhouses.

Now with our country at war, aerial photography takes on a grim significance, disclosing munition factories, power plants, aviation fields.

To keep pictures taken by enemy reconnaissance planes from giving away military secrets, such as gun displacements and defense plants, we use camouflage. These tell-tale points are being covered with nets or vast areas of colored canvas painted to resemble fields or woods.

Now with less room in our planes for passengers, you can still enjoy some of the thrill of flying by studying aerial maps.

Remember two "musts." First, always turn the shadows toward you. Next, keep in mind that hard or moist areas reflect more light and appear lighter. For example, a path across a field that might not be picked out by anything short of a bloodhound, stands out like a loose thread on a serge suit.

Noctovisor—Eye In The Dark

[*Continued from page 61*]

at Leeds. The televisor was turned on them. Invisible infrared rays were turned on in the dark room. Their images were picked up and carried by wire to London—many miles away—where a group of observers was able to see and identify each of the men seated in the darkened room in Leeds.

The addition of an infrared "spotlight" to the equipment made it possible, therefore, to use the modified televisor at night. At this point the device received its name, "Noctovisor," or "night seeing equipment."

The principal wartime use of the Noctovisor is for night spotting of enemy ships. It can be used for some types of airplanes spotting at night.

Electric Floor Mop

[*Continued from page 140*]

platform on the front of the carriage and an old fan hub is placed over its shaft. A gear-type Chevrolet oil pump is mounted in line with the motor, after it has been sawed off at both the shaft and housing so that 2½" of housing remains with 1½" of shaft extending from it. A similar hub to the one on the motor is placed on the pump shaft. The pump housing has been turned down to smooth the outside, the end is undercut to admit packing and the outside is threaded to take a packing nut. A collar with set-screws is fit over the outside of the housing, and a water pump grease cup is installed to lubricate the shaft.

The inlet and outlet openings in the pump are enlarged to take automobile hot water-heater nipples. And the hoses are hot water-heater hoses. The outlet hose need only reach into the drum, and the pickup is long enough to reach water puddles. The pickup end can be made from the heater defroster fittings that fasten under the windshield at the dash. A fiber disk set on bolts between the motor and pump shafts will act as a universal joint.

The machine will pick up an amazing amount of water—the outlet will shoot a stream almost as large as a garden hose while it is in operation.—*E. S. Harris.*

Automatic Gate Opener

[*Continued from page 142*]

bolt. The other end of the eye rod is fastened on the 16'-long 2 by 4 levers by means of pieces of chain 18" long. The fulcrum posts are set 6' from where the "works" is anchored as shown in the drawing. Fasten a piece of rope on the long end of the levers, pull, the gate swings open, drive through, pull and the gate swings shut. The mechanism automatically locks in either the open or shut positions and will not swing against your car.

If the levers from which the operating ropes are suspended are in the proper positions it will not be necessary to back the car or otherwise maneuver it after the gate is opened. A slight variation in the direction that the levers point is possible by placing the upright posts that support the levers, in the desired position on the gate post. Naturally, no additional gate catch should be used.

Care should also be taken to keep the area swept by the gate. Boulders or litter should be kept off the drive way under the gate to prevent its sticking when the opening lever is pulled.

There are nearly 55,000 licensed amateur radio operators in this country.

The United States produces over 90% of the world's molybdenum—important in armaments as a toughener of steel.

Hitting The Atom Harder

[*Continued from page* 38]

within one-tenth of one percent of the speed of light (186,000 miles per second).

When he gets his electrons whirling around at their full force, Professor Kerst can aim them at a target. By having them strike a piece of ordinary copper he makes that copper radioactive. (Professor Lawrence with his older cyclotron has already altered all but two of the 92 elements known to exist on earth.) By making the electrons strike the piece of tungsten in the tube Professor Kerst has generated X-rays *more intense than all the refined radium in the world* can produce.

No earth-produced force equals the 100,000,000 electron-volts which the new device now building will yield. The only known comparison occurs in the black void between the stars, whence come the mysterious cosmic rays which pour upon the earth.

However, the sun is also a giant atom-smasher. In the tremendous heat that prevails inside the sun, 36 million degrees F. at the center, chemical reactions do not occur. But something similar occurs when nucleus meets nucleus. They may knock each other to pieces and the fragments combine to form new elements. Or a nucleus may swallow another whole, again producing a new element. At each such transmutation, a burst of energy contributes to the sun's radiation. So atom-smashing plays an important role in providing us with indispensable solar radiation, necessary to life as we know it.

Professor Kerst has had a linguistic problem in giving his generator a name. Its essential trait is the flowing of electrons in a circle. But Professor Lawrence ten years ago properly preempted the most suitable term for this sub-atomic behavior. His term cyclotron comes from Greek roots which mean a *device* which makes things go in a *circle*. Professor Kerst thought of peritron—a *machine* which makes things go *around and around*. Then he decided on rheatron—a *machine* to make things *flow*. Now he and his scientific colleagues have decided upon betatron—a *machine* which yields particles exactly like the *beta* particles, that is, electrons, given off naturally by radium.

As for the usefulness of this most powerful of electron guns, General Electric's vice president in charge of research, Dr. William David Coolidge, who fostered Professor Kerst's work, speaks of its significance like this:

"Hitherto, experiments with high-speed electron beams have not kept pace with the experiments done with the positive ions from the cyclotron. The cyclotron is incapable of accelerating electrons, and previous devices able to do so have seemed to reach a practical limit at something like half the voltage of the present accelerator, which seems to have no such limit. Its effective voltage can apparently be increased indefinitely."

Professor Lawrence projects protons at his atomic targets. Professor Kerst projects electrons. Electrons weigh only one 18-hundredths as much as do protons. In this difference probably lies the different usefulness of the cyclotron and the betatron.

The cyclotron seems to be mainly a disruptive machine. The ions it fires at atoms can knock orbital electrons out of those atoms. Or those orbital electrons may be knocked into other orbits of the same atom. The cyclotron may even smack nuclear electrons and protons out of those atoms. Every kind of these atomic accidents changes the chemical-physical behavior of the atom. In many cases the atoms of one element become changed into atoms of another element. And there you have the transmutation of the elements—for example, the manufacture of cheap mercury into precious gold.

The betatron is more likely a constructive machine. The free electrons which it hurls around may knock orbital electrons askew or even out of their mother atoms. Those free electrons however may adhere to the atomic targets, joining the orbital electrons already there or even penetrating into the nucleus. There, again, are elemental alterations and transmutations more valid and more assured than any alchemist ever dreamed of. Thus the present Kerst betatron has made copper radioactive. The new one will doubtless do the same to other elements. Some of those elements may crack into lighter ones. Some light elements may even coalesce into heavier ones. One can only guess.

The X-ray beam which the present betatron also generates can penetrate a sheet of aluminum an inch thick. Much weaker X-rays kill animals. The present betatron would kill a man exposed to its beam. It is truly a death-ray machine to anything living put within a few feet of its unshielded emanation. On the other hand, properly guarded, it may prove useful in the treatment of cancer, one of the commonest causes of death today.

But the betatron's greatest usefulness—apart from its purely scientific applications for the study of atomic substructure—will be in its examinations of thick metal castings. The foundations of drop-forging presses must withstand terrific smashes, and therefore must be perfect throughout. The shafts of turbines must withstand tremendous centrifugal forces, and therefore must be perfect throughout. The only way that engineers can be positive of the inner perfection of such machines is to X-ray them. Present-day X-ray machines already in factory use can reveal bubbles and cracks in the steel walls of pressure tanks. They can reveal flaws in small axles and shafts. Nothing in all probability can remain hidden from the X-rays of the betatron which General Electric is now building for young Professor Kerst.

Bottled Warfare

[*Continued from page* 68]

a fire. Discharge a pressure cylinder full of it at a flame; if it reduces the air's normal 21 per cent oxygen content by as little as one-third, the flame is smothered. Gasoline flames, for example, cannot burn if the air contains less than 16 per cent oxygen, and it takes but a few pounds of CO_2 to reduce the oxygen content of a considerable volume of air to 12 or 14 per cent.

Consequently, you'll find the bright red cylinders of compressed carbon dioxide wherever a flammable liquid or electrical fire hazard exists—on motorboats, torpedo craft, army tanks, gasoline trucks, and every few hundred feet in New York subways. But by far the most dramatic and important use, perhaps, is on aircraft. Aviation involves gasoline and oil, and their presence is an invitation to fire. And when you are several miles in the air, fire can be very embarrassing. Fed by hot oil and supervolatile fuel, fire in a plane can chew away a piece of aluminum alloy strut as a warm knife slices butter, and a pilot can be oblivious to the destruction taking place a few feet away. So when commercial and military aviation boomed and ships got larger, costlier, carbon dioxide was pressed into service.

Airplane fire extinguishing systems today consist of a steel bottle about the size of a gallon oil can, holding carbon dioxide in a liquefied condition under 850 pounds per square inch pressure. When needed, the bottle is opened by a control near the pilot, and liquid CO_2 rushes through piping to outlets encircling the engine cylinders. It turns instantly to gas and fills the compartment with inert, fire-smothering vapor. Despite the slipstream's force, the gas discharge kills the fire in a few moments.

Add a portable carbon-dioxide extinguisher or two in the pilot's compartment and cabin and the plane has the essentials of fire protection—in the air. But on the ground—in hangars and shops, on fuel trucks, battery dollies, test racks, and maintenance scaffolds—there'll be all sizes of the bullet-shaped red cylinders of the compound from little pistol-grip extinguishers used on the battery dolly to big five-foot-long affairs on wheels. And the aforementioned crash trucks carry thousands of pounds of gas in banks of manifold cylinders. This supply enables airport crews to envelop a crashed and burning plane in clouds of CO_2 gas to beat back the flames and permit rescue of the occupants.

This gas' usefulness does not end in fighting fire—its great compressibility has led military engineers to adapt it for rapid inflation work. Carbon dioxide will expand to 450 times its compressed volume! One of the first uses was in giving emergency "water wings" to planes based on aircraft carriers and operating over the ocean. They sink rapidly if forced down at sea or if they miss the carrier's deck in difficult weather. Now, in the wings of such planes, and of land-based planes which fly over water, are compartments with pop-out doors.

The compartments hold two deflated rubberized bags connected by tubing to cylinder of compressed carbon dioxide. Located on top and bottom of the fuselage are two water-sensitive switches which open the valve of the CO_2 cylinder as soon as they are submerged, thus inflating "water wings" which pop from their compartments to keep the plane afloat until rescuers arrive. Temporary flotation bags have equipped American bombers being ferried across the ocean to prevent their loss in case of forced landing at sea, but best results are obtained when the ship is designed to accommodate the bags as an integral unit.

"A boat in three seconds" sounds like a dream, but CO_2 has made them possible—to the grateful thanks of rescued English pilots in the waters around the British Isles and American pilots in all parts of the world. A cylinder of carbon dioxide about the size of a milk bottle inflates the four common types.

The Army Takes To Gliders!

Gliders were the playthings of "thermal bugs" and the testing models for serious students of aerodynamics before the war. The glider fan lived in a world apart from reality, made up of thermals, cumulous clouds, up- and downdrafts and other terms and experiences strange and weird to the man on the street. But now the Army has taken over gliders, and gliders are to play a great but mysterious part in the war! MECHANIX ILLUSTRATED presents four full pages of Army glider news pictures in the July issue (on sale on all newsstands June 1). You can't miss this great pictorial feature in the next issue of MECHANIX ILLUSTRATED.

The British round dinghy, tossed from the plane as it lands on the water, is intended merely to keep the men above water until rescued, and carries no oars. American ships use an oval type, similar to the round dinghy, but fitted with oars so that pilots can propel themselves over a limited area. Another type is the "drop" raft which is actually dropped from a plane in flight, inflating on the way down to the water. "Pop out" rafts are automatically inflated with carbon dioxide the minute the plane lands on the water, ready for the crew members to step in when they abandon ship. Fitted with emergency provisions, these rafts have held pilots for days of drifting until rescue.

Even these boats do not complete CO_2's contribution to the military pilot's safety. His life-vest—a rubberized jacket worn uninflated beneath his parachute harness—has two tiny carbon dioxide pressure cylinders smaller than a cigar, which release their charge of gas and inflate the vest at the jerk of a cord. Even this minute amount of CO_2 expands so rapidly that the vest is given adequate buoyancy to hold a 200-lb. man afloat for several hours. When the carbon dioxide inflation is exhausted, the life-vest can be kept inflated with lung power.

Another ingenious use for carbon dioxide gas is in rendering airplane gasoline tanks immune to fire and explosions during combat. Though gasoline tanks which automatically block leaks when pierced by bullets have become standard equipment on modern combat ships, the danger of fire and explosion remained because of the combustible mixture of gasoline vapor and air in the tank. This vapor mixture can be readily ignited by tracer bullets or even by shrapnel, with disaster for the plane an inevitable result.

Government aviation experts and engineers of Walter Kidde and Co., New York firm which has specialized in developing these steel bottles for carbon dioxide and oxygen uses, went to work on the problem. They finally perfected a method of releasing carbon dioxide gas into the space above the fuel, as the fuel supply is withdrawn during flight. Known as the "vapor dilution system," the new device makes warplanes' fuel tanks almost completely free of the danger of fire or explosion from enemy gunnery and constitutes a tremendous step forward in air combat safety.

Principle of the new system is to dilute the air entering the tank to such a degree that there is not sufficient oxygen above the gasoline level to permit combustion. Pure gasoline fumes will not ignite, and a fixed proportion of oxygen is necessary before the vapors become dangerous. By displacing the oxygen in the air-space and replacing it with non-combustible carbon dioxide, the explosive point is never reached, so that tracer or incendiary bullets can pass right through the gasoline tank without causing fire or explosion.

Because aerial mastery in today's war belongs to the man who can get on top, combat planes and pilots must be able to climb to heights so rarefied that pilots must receive measured amounts of oxygen to retain consciousness and normal speed of reaction. Ingenious design has developed a lightweight cylinder that will stand enormous internal pressure, permitting sufficient oxygen for hours of flying to be carried in a minute space and at a minimum of weight.

"Whaddya hear from the mob?"

A final development in the military uses for compressed gases is the perfecting of a shatter-proof cylinder for carbon dioxide, oxygen, nitrogen, compressed air, and other gases used in military work. Steel cylinders formerly used for holding such gases at high pressure were apt to shatter under the impact of a heavy machine-gun bullet, an anti-tank shell, or sometimes even by smaller projectiles or shrapnel pieces. Such shattering meant that the equipment—airplane, tank, torpedo boat, or fuel truck—would be riddled by small jagged pieces, capable of doing more damage than the actual bullet itself. Today's warplanes carry their compressed gases in new steel bottles which merely puncture under the impact of .50 caliber armor-piercing bullets instead of filling the air with deadly fragments.

To such small items as these steel bottles may go considerable credit in our ultimate victory!

The earliest marine mine is believed to have been an "explosion ship" with which the Dutch destroyed a boat bridge in 1585.

Mine Throwers

[*Continued from page 59*]

the American "pineapple" and the British Mills Grenade which consist of a comparatively small high-explosive charge in a thick-walled grooved container which produces a large number of splinters.

But the grenadiers could not throw their grenades as far as would often have been useful. Nor were human muscles adequate to throw grenades heavy enough as was often required. This led to the construction—often enough a makeshift construction in the beginning—of trench mortars, small devices which by means of an explosive charge were capable of lobbing small shells into enemy trenches at a much greater distance than human strength permitted.

These shells were still too light, however, to break into a well constructed dugout the roof of which was strengthened by several crosswise layers of tree trunks and ten or twenty feet of sand. These dugouts could stand even a direct hit from field artillery shells. It needed a fairly large artillery shell to cave them in. But such heavy artillery had to fire from an appreciable distance and was never able to observe its hits or misses directly. They had to rely on reports from observers closer to the target. It was for just this purpose that the Germans developed a special type of very short ultra-heavy howitzer or mortar (the *Minenwerfer*) which fired shells weighing 200, 500, and even 1,000 pounds at a very steep angle to a distance of about one mile.

The British Livens Projector was even more simple and at the same time more specialized. It consisted of a metal tube on a base plate which was placed in (not on) the ground in such a manner that only the muzzle showed, pointed upward in a 45 degree angle in the direction of the target. These Livens Projectors were buried in the ground in very large batteries and discharged all together in a tremendous volley. The simultaneous ignition of the propelling charges was accomplished electrically. The shells, which were just thin-walled containers for poison gas, weighed 100 pounds. Each held about 30 pounds of phosgene gas. The maximum range of the Livens Projector was 1,800 yards.

It was a big drawback, however, that the Livens Projector was a one shot weapon; after each volley they required a complete re-wiring job. To remedy this condition the British then introduced the Stokes mortar which became the prototype of the present British and American trench mortars.

They are all very much alike in construction, consisting of a firing tube, mounted on a base plate with a bipod to hold the tube in the proper position. The shells look like small airplane bombs with fins attached to their rear end. They explode when striking the ground. The propelling charge consists of a cartridge which resembles a shotgun cartridge and so-called powder increments, solid

[*Continued on page 159*]

Grinder-Polisher

[*Continued from page 131*]

Ball-bearing pillow blocks are so designed as to be self-aligning, which makes assembly of the machine illustrated a very simple matter, as alignment may be ignored completely. With solid bearings, very careful adjustment, with some shimming on the base, is essential to prevent binding.

Solid pillow blocks may be made at relatively small cost as shown in Figure 4. "A" shows such a block fitted with Oilite Bronze bearing sleeves; and "B" a plain castiron block with shim adjustment to take up wear.

"Oilite" bearing sleeves are made of a porous bronze alloy heavily impregnated with a fine lubricating oil—you can squeeze them in a vise and see oil pop out on the surface—and though the makers claim they will run for long periods without additional lubrication, it seems advisable to drill oil holes as illustrated, and to apply a few drops of oil daily.

Strangely, one of the very finest of all bearings for speeds up to 1,500 r.p.m is a plain, smooth hole in a piece of fine-grained castiron!—especially when used in connection with a hardened and ground steel spindle, comparable with drill rod. The smoothly-bored inner surface of such a bearing takes on a very high "glaze" after use with a finely finished steel spindle, which surface appears almost impervious to wear; though common sense dictates the use of "peelable" shims between upper and lower halves to provide takeup when wear does finally occur.

Some of the very finest tool-room precision lathes today have integral castiron bearings—chosen for most accurate performance; and I know an instrument maker, former'y employed by a nationally famous fishing reel manufacturer, who, when he built his own casting reel, used tiny bushings of fine-grained castiron for bearings . . . and the performance and smooth running qualities of this feel is superior to that of any jewelled-bearing reel I have ever seen.

Always bear this in mind: castiron bearings should *always* be provided with turn-down grease cups; and should always be grooved as shown in illustration . . . which is easily accomplished by means of a small aluminous oxide wheel in the "hand grinder" which is today an almost universal bit of equipment in the well-equipped shop.

Figure 5 shows a number of arbors, spindles, wheels, etc., which are useful adjuncts to the polishing lathe—grinder combine h e r e i n described, with explanations of various items.

Wood wheels, of very dry poplar, gum, willow or basswood, may be turned up to any desired form for reaching "hard-to-get-at" places, and "charged" with abrasive, as required. Hard felt wheels are terribly expensive and difficult to obtain at present, but an excellent substitute is the sole-leather wheel, glued up to required thickness with a top-grade hide glue, applied hot.

[*Continued on page 160*]

Mine Throwers

[*Continued from page* 158]

pellets of hard powder stuck between the fins. Each shell comes with all the increments it can carry, but they are needed only for full range. If the range is to be shorter they are taken out. When only the cartridge is left the shell has its shortest possible range.

The U. S. Army has two types of such trench mortars, the 60 millimeter and the 81 millimeter. The shells of the 60 mm weigh about three pounds; the 81 mm has two types of shells, one weighing 7.6 pounds and one weighing 14.5 pounds. The maximum range of the heavier type is 1,280 yards, that of the lighter 3,280 yards. The maximum range of the 60 mm shell is 1,750 yards—which is about the maximum range at which a halfway decent observation of the effects is possible to the soldiers handling the mortar. Minimum range for all types of trench mortar shells is 100 yards.

These trench mortars are precisely what they were designed to be: mechanical hand-grenade throwers, capable of throwing hand grenades too heavy for human hands to a distance too far for human muscles. But their shells are not very effective except against men. They can harass advancing infantry, they can destroy a machine gun nest, they can, if luck grants a direct hit on the open car, disable the men on a motorized transport—but they cannot do anything against a massed tank assault.

"I wonder whose bright idea it was to pave *this* road?"

This is where the heavy mine-thrower would be useful.

The diagram shows how such a weapon might be constructed. It consists of a large size firing tube with an internal diameter of eight or ten inches. The firing tube would not be rifled, but smoothbore. It would be attached solidly to a base plate provided with spikes in the usual manner of trench mortar base plates. The shell, which would weigh some 200 pounds—no greater weight would be required to smash even a heavy tank, but greater weight would make transportation difficult—would be shaped like an artillery shell, carrying a large charge of T.N.T. It would have two copper bands which, however, act only as gas seals, since the tube is not grooved or rifled.

Elevation being constant, the range would be varied by means of varying the propelling charge. While propelling charge and shell are inserted through the muzzle of the mine-thrower the firing would be accomplished by a cartridge which is inserted into a kind of touch hole drilled at right angle to the longitudinal axis of the mine-thrower. The fire jet of the cartridge would ignite the propelling charge.

If the muzzle velocity of the shell is somewhat above 350 feet per second the range would be about 1,200 yards; if the muzzle velocity can be doubled the range would be close to 4,000 yards. The highest point of the trajectory of these shells would be about the same as their range. They would, therefore, descend with considerable smashing power. While the recoil would be fairly large the mine-throwers would be simple in construction insofar as they would not require a special recoil and counter recoil mechanism. Compared to the recoil of field guns the recoil of a mine-thrower would be mild—which is to say that long barrelled field guns have an enormous recoil—and the steel could stand the shock. Furthermore the recoil would be directed mainly straight down and would be taken up by the ground.

These mine-throwers would be fairly heavy and could not be pushed far by their crews, even though small wheels are provided for just this purpose. But transportation over any distance worth that name would have to be done by means of transport cars anyway because of the weight of the ammunition.

The main advantage over artillery pieces would be that the mine-throwers would have an extremely long service life, since the firing tube has to stand much less strain and wear than the barrel of a gun. But they could maintain a high rate of fire just the same and explosions of 200-pound charges of T.N.T. would prove fatal at least to smaller tanks even if they do not land directly on top of it.

If it should happen that trench warfare develops again in the present war such mine-throwers are certain to come. But if they had existed in quantities, say three years ago, they would also have been very valuable at certain points in the defense against Blitzkrieg tactics.

The world's greatest evergreen forests are, not in the North, but in the equatorial jungles.

Fear Chemical War?

[*Continued from page 49*]

leggings that cover every bit of the body. Air is breathed through neutralizing chemicals. In spite of the fact that this clothing is specially made to resist chemical intrusion, the men are given hot baths immediately after they finish their neutralizing work.

Neutralizing of a spot where mustard has been planted is done with a mixture of chloride of lime and sand, ashes, or dirt. A path of this mixture is made up to the main source of the chemical, usually characterized by a small crater, and the neutralizing agent is sprinkled upon the crater thoroughly, being careful to keep it thinly spread. This is then covered, and warning signs are posted. Subsequent inspections are made, and if the job has not been thoroughly done, the process is repeated.

If areas of a building are affected by mustard, the walls are thoroughly scrubbed down with chloride of lime and water.

The important thing for civilians to remember in regard to areas affected by any type of poison gas is—*stay away!* Go inside, shut the doors and window, eliminate all drafts, and notify your civilian defense headquarters. Don't get panicky. Your home is a first class gas-proof shelter, and if you are thoroughly shut in, the chemicals will not reach you. Top floors offer better protection than lower ones, since the chemicals are slightly heavier than air and tend to cling to the ground.

In incendiary attack, which is more probable than gas in modern warfare, the civilian can be of considerable help. Again, the moment an incendiary bomb or shell strikes, the authorities should be promptly notified, and then the civilian can himself immediately take steps to eliminate the menace.

The first instruction here is a "don't." *Don't ever throw water on an incendiary.*

The materials of which incendiary bombs are commonly made—thermite, phosphorus, magnesium—all burn faster in the presence of water. If you throw water on them, the net result will be a first class explosion, that will burn the bomb out quickly, but it will probably do the same for you and everything combustible in the area.

There are several methods of battling incendiaries that anyone can use, and are practically without danger if care is observed. First is to safeguard the home against them. The velocity of a falling incendiary reaches 350 feet per second, and at that rate, it will penetrate any ordinary roof, probably coming to rest in the attic or the top floor.

First step, then, is to have these parts readily available. There should be quick access to the attic, even if you have to cut a hole. Then the attic should be thoroughly cleaned of all junk. It may break Grandmother's heart to throw away that picture of Grand-uncle Ezra in his war of 1812 uniform, but if you can't find a better place than

[*Continued on page 161*]

Grinder-Polisher

[*Continued from page 158*]

Emery inside ring buffs, and *felt ring buffs* (available through leading manufacturers of watchmakers' and jewelers' tools) are quite inexpensive, but extremely valuable.

Felt, leather, and wood buffs are to be used in two ways—(a) charged with a fast-cutting glue-mix abrasive, and (b), charged with a grease or wax-mixed compound of fine polishing abrasive. In the former class one of the best is known as "Matchless"—a product of Matchless Metal Polish Co., of Glen Ridge, N. J., and available through most platers and platers' supply houses in various grades of grit. When not readily available, excellent glue-grit compounds may be made as follows:

Any standard (Le Pages, Royal, etc.) liquid glue, thinned to the consistency of rich milk, with water and vinegar, half-and-half;
Add, aluminous oxide grains, carborundum, or emery flour, in grades 150 to 200 screen, to form a stiff paste.
Or, use powdered pumice, for finer polish where very fast cutting is not needed.
Keep such compounds in friction-top cans with a slight excess of water content to prevent drying out; for use, spread a thin coating on wheel or buff, letting it dry well; repeat; use when well dried. Repeat application as often as needed.

Buffing compounds, for subsequent finishing include such well-known items as Emery Cake, Tripoli, Jeweler's Rouge, etc. (all obtainable from most machinists' supply houses); and another, known commercially as "Lasalco," obtainable through the same sources, or, more particularly, through platers' supply firms and makers of watchmakers' tools and supplies. Intended primarily for use in buffing chromium, this "Lasalco" (a pure white cake) is the finest thing I've ever struck for producing a very high finish on steel. Equally valuable on hard felt, hard leather, or wood buffs, it produces a high polish on almost any steel, regardless of hardness. On felt, wood and leather, it *really* cuts—and cuts off abrasive marks—and *polishes while cutting*. It works at its glorious best on very hard felt wheels, ring buffs, etc., and is plenty good on built-up sole leather, or walrus wheels. And for a final, very brilliant finish on steel parts, you won't go wrong in using this same LASALCO compound on your stitched muslin buffs. It brings out that gloriously bluish mirror-silver color on steel which is so desirable as a pre-treatment of steel to be blued—by any method. Last, but not least, this is a greaseless cake which cleans very easily in preparation for any bluing, browning, or blackening process, and a particularly fine pre-treatment for Stoeger's Lightning Gun Bluer, Houghton & Company's famous "Hough-to Black," and the various methods of bluing guns and other steel parts.

To blackout the windows of a West Coast aircraft factory, it took 100 professional painters, working 24 hours a day, five days and five hours to complete the job. And they used 4,408 gallons of black paint.

Fear Chemical War?

[*Continued from page* 160]

the attic, it should be disposed of at any rate.

After the attic is cleaned, it should be covered with metal screen of fine mesh all over the floor, and over this should be spread a four-inch layer of sand. Ordinary incendiaries striking this will simply burn themselves out harmlessly.

There are several methods of putting out an incendiary bomb safely, all of which should be thoroughly learned and rehearsed with dummy bombs. One of the best ways is to douse it with sand. The technique for this is divided into five parts. 1. The incendiary is approached with a bucket of sand and a shovel. All of the sand except about four inches in the bottom of the bucket is dumped as near the bomb as possible. 2. A shovel full of sand is lightly sprinkled (not dumped) on the incendiary. 3. This mixture is shoveled into the remaining pile of sand. 4. The whole mixture is then deposited in the bucket. 5. The bucket is carried away by running the shovel under the handle, and carrying it a safe distance from the individual.

Water can also be used to quench incendiaries if properly handled. At times it is superior to sand, since it wets the surrounding area, and prevents spreading. Care must always be taken to maintain a fine spray, or an explosion is apt to result. When the spray is applied, it should not be directed at the incendiary material, but short of it, with the rebound of the water distributing a covering. Do not expect the bomb to go out instantly, and do not be alarmed if it flares up a little. You are not putting it out, you are burning it faster, and the water is preventing any spread.

When going forth to do battle with an incendiary in this manner, several precautions must be kept in mind. One is to lie prone, and lift your hose high. In this way, you have a better chance of avoiding any sparks. You should always have a light of some kind along, and the exit should always be available in case the fire gets out of hand; keep yourself between the fire and the exit. Another thing to remember is not to approach any incendiary within sixty seconds of the time it lands. This is the period in which it explodes, scattering fire, and it is very dangerous. Some types of incendiaries also carry small amounts of explosive which go off after the bomb has burned for a while, so it is well to be shielded with a light table, tipped on edge to prevent being burned with flying hot metal, should the projectile be of this kind.

Water for battling the fire bombs can be obtained from many sources. The garden hose is an obvious method, but too much reliance upon it is discouraged by the Army. It may not reach the source, for one thing, and if too many garden hoses are used at once, the pressure for fighting fires may be dangerously reduced. Too, a main may be hit by an explosive bomb, and that source of water cut off.

The method recommended by the Army is to fill the bath tub at the first hint of an air raid, and to use that water for fighting any fires that may occur. The small stirrup pump, used so effectively by the British, will furnish the pressure. Water can be ladled out in buckets of about three gallons each, and two or three of these buckets will be needed to quench the average size incendiary.

While gas raids are not likely to prove profitable from an enemy standpoint, they are possible, and might be resorted to as desperation measures when the going begins to get tough, as it will shortly. It is well that we be ready, but calm, confident, and unafraid.

"It runs on a large clock-spring but I can't find anyone to wind it!"

Laminated Knees

[*Continued from page* 122]

can easily be straightened out in assembling the knee. Use white oak, unseasoned, and steam or boil it in a pipe, one end plunged and inverted over a fire, then clamp while hot over the form and leave to cool and set. Make the backing pieces to suit the pattern; for a smaller boat this can usually be cut from a single width but for a larger one two pieces as shown will be required. Fasten as shown with Cascamite between joints.

Sixty used toothpaste tubes contain enough tin to solder all the electrical connections in a medium sized bomber.

2 Tube Baby Broadcaster

[*Continued from page 124*]

tions should be securely soldered. Use a hot, well-tinned soldering iron. Apply it to the connection to be soldered, and hold it there until the connection itself is hot enough to flow the solder. Only rosin core solder should be used. Make all connections as short and direct as possible. Cut off the excess unused lead of the resistors and condensers.

When you have completed your work, check it once more against the diagram to make sure that your wiring is correct.

When you are ready to try out the broadcast station, plug the line cord into any AC or DC outlet having from 105 to 125 volts output. Allow a few seconds for the tubes to warm up. Tune your regular living room radio to some point between 550 KC and 700 KC, where no regular broadcast stations are heard. Set the volume control of your radio at about normal level. Adjust the condenser on the oscillator coil of your broadcast station with a screwdriver until the signal produced by the oscillator is heard in your radio set. This indicates that everything is now in working order.

For microphone operation, connect a jumper between the middle and right-hand terminal of the input strip. Connect the microphone to the middle and left-hand terminal. A high resistance type carbon microphone is required, such as is listed in the parts list. This oscillator makes an excellent unit for playing phonograph records through your home radio. Any high impedance crystal or magnetic pickup may be connected to the same two terminals to which the microphone was connected, but the jumper must be removed from the middle and right-hand terminal. The record player should have a volume control to control the output of the pickup. This is to prevent "overmodulation" which causes distortion.

Leaf Printing, Outdoors

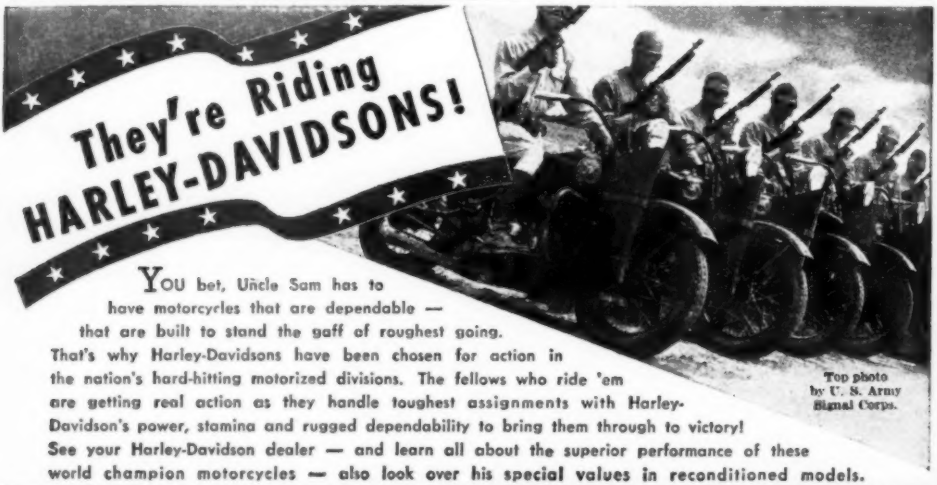
[*Continued from page 93*]

number of prints on location. Instead of bringing home a bulky and fragile collection of botanical specimens, you have a box or packet-full of prints ready for fixing and drying.

Not all P.O.P. papers can be fixed. One that can is Defender Disco (Gelatin P. O. P.). Disco prints can be fixed in the formula that comes with the paper or in the following:

Water	64 ozs.
Sodium Thiosulphate (Hypo)	16 ozs.
Sodium Sulphite (Dessicated)	1 oz.
Acetic Acid (28%)	3 ozs.
Potassium Alum	1 oz.

Expose from 1 to 1½ minutes longer than average when using the above.



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Top photo by U. S. Army Signal Corps.

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ON AMERICA'S FRONT LINE OF ACTION

Plant Miracles

[*Continued from page 73*]

is not always the most desired result. Sometimes the search is for greater height, or wider leaves, or earlier bearing, or drought resistance. No plant is to be rejected merely because it does not bring forth big flowers. All the qualities and characters of a new strain must be carefully examined in judging its possible value.

What's so special about colchicine that treatment with it causes plants to react strangely? Simply this: colchicine paralyzes the process of cell division at one very critical stage. Ordinarily, the heredity-bearing chromosomes double in preparation for cell division, and half go with one new cell, half with the other. But a colchicine-treated cell remains enlarged with its doubled number of chromosomes. It divides later, still with the increased chromosome number; and repeated divisions of this kind give rise to the new tissues and organs which differentiate the colchicine-treated plant from the parent strain.

These "giantized" cells very often produce giantism in the new parts that develop from them. Colchicined plants transmit their big cells, with doubled or even trebled or quadrupled chromosome numbers, to the embryo plants within their seeds, and thus give rise to new varieties.

Colchicine is being used in cotton work at the Texas Agricultural Experiment Station in experiments of particular interest and significance to that major American industry, cotton growing and manufacturing. "We expect eventually to develop improved strains of cotton that would not have been possible without using colchicine," says J. O. Beasley, agronomist in charge of cotton investigations. "Two cotton species cultivated in Asia and eight wild species—one each in Africa, India, Australia, Peru, and southwestern United States, and three in Mexico—have never been used to improve American cultivated cottons. Why? Hybrids between them and American cultivated cottons were sterile. Colchicine's value is that the sterile hybrids will sometimes produce seeds after treatment with the drug."

After thus made fertile, hybrid cottons can be used in breeding work in attempts to transfer various characteristics, such as resistance to drought and to angular leaf spot, leaf worms, and aphids, to American cultivated cottons. Possibly the wild species will enable getting new types of fibers—stronger fibers. Mr. Beasley cautions, "The odds are against our being able to transfer any given character,"—then adds hopefully, "but since there are several valuable characters in the different species, the chances are good that some of them will eventually be transferred to American cultivated cottons."

Particular attention is here called to the cotton experiments because cotton today plays a notably vital role—it's essential in munitions-making, and with military uses requiring most of our wool, cotton takes a larger place in clothing manu-

[*Continued on page 164*]

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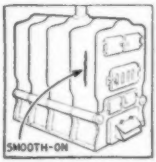
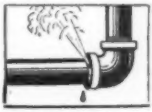
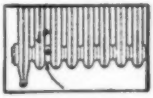


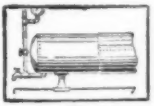
Boiler and Furnace Leaks



Pipe Leaks



Radiator Leaks



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Plant Miracles

[*Continued from page* 163]

facture. Thus, amateur collaborators in colchicine investigations may be able to play an important part in attaining the improved cotton sought for American cultivation, even if the war factor is eliminated. Yet other experiments in plant-breeding with this interesting drug may be equally thrilling and significant.

It's easy to treat plants with colchicine to induce genetic changes. First and simplest of the common three ways is to soak seed in a solution of the drug in distilled water. If you want to work it this way, have your pharmacist mix half a gram of colchicine in a pint of water. Cost: about 50c.

This stock solution can be used straight, or further diluted with water. Seeds can be soaked for varying lengths of time, from half an hour to several days, then rinsed off and planted. After they have germinated they should show the effects of the drug in stems, leaves, flowers—all parts of the plant. Their seeds should carry on the developments into following generations.

A second method mixes the colchicine in a colloid spray consisting of glycerin, water, and a vegetable or fish oil. With an atomizer this mixture is sprayed on the plants to be treated. Such treatment produces irregular patches and areas of stimulated growth, from some of which buds and flowers originate, producing seeds that carry the newly-originated characters.

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Be sure to read this thrilling article in July MI written by Flying Officer John Scherer, Royal Canadian Air Force. For the first time, you will learn the full, detailed story of a flight in a giant bombing plane!

Better control of effects is obtainable with the third method, however—mixing the colchicine with lanolin (wool fat) in a ratio of one gram of powder to 100 grams of the fat. This makes a salve which is applied to the growing tips of branches, producing on some of them strange flowers that bear the seeds of the new varieties.

All the methods sound easy, don't they? But don't offer your aid in scientific collaboration unless your interest is serious. Experimenters must be prepared to carry on patiently for many months, and preferably for several successive seasons, scheduling regular hours every week to be devoted to the work. If you are seriously interested in carrying on experiments in plant breeding with the aid of colchicine, however, write to Dr. O. L. Eigsti, Department of Botany, University of Oklahoma, Norman, Okla. Dr. Eigsti can supply detailed information on where to obtain the colchicine, how to dilute it, time and methods of treatment, and recording of results.

Perhaps you'll be enabled to pioneer in experiments which are being undertaken in a small way to determine the effect of colchicine on animal cell division!

Build "Jeep"

[*Continued from page* 119]

with the motor may be used. The battery holder is a homemade affair. Two medium-sized flashlight batteries are bound with tape. A receptacle salvaged from an old model airplane battery is attached to the ends of the batteries with a drop of solder. A piece of brass completes the circuit at the other end.

Use a piece of sheet metal to bind the battery to the chassis, and another piece to attach the coil to the rear bracket of the frame.

The condenser fits nicely on the motor mount; being attached to one of the gas-tank screws.

The front end of the body must be covered with sheet metal. Drill a small hole for the needle valve extension, allowing it to protrude for adjustment. The lower portion of this covering is left entirely open to provide ample cooling.

The remainder of the covering may be made of sheet metal, or of veneer as was the cover in the original model. Plastic resin glue is excellent for binding two thicknesses of veneer.

A radio toggle switch in the center part of the cover is the means of turning the ignition on and off. The piano wire extension was made by drilling a hole in the knob of the toggle switch and soldering the piano wire in place. When the car is in motion a cloth held some distance above the car will trip the toggle when the wire strikes it. In this way the motor is shut off.

The fin is chiefly decorative. It may be cut from any kind of wood. The cover of the car is held in place by machine screws fitting the 6/32" tapped holes in the cross angles supporting the frame.

It is best to have the center of the bridle at the center of gravity of the car. This will be found to be around the front wheel. Hence, it is suggested that you attach the bridle in the manner shown. The brackets for this purpose are bent as shown in the drawings.

If, when the car is running it wobbles noticeably, misplacement of the bridle is indicated. Raising or lowering it usually helps some.

Caution should be used in making the bridle secure. If the car should break loose it would certainly be wrecked.

Running miniature race cars is somewhat different from airplanes. The only load your airplane motor has to carry is the weight of the prop and its resistance. The racing car motor cannot be leaned out to its highest speed at the start and be expected to get the best performance. When you start your car use a fairly rich mixture. It will run a few laps slowly but will gradually lean out to its proper mixture as it warms up.

Keep the moving parts well oiled.

Large scale blueprints for "Jeep," with important parts drawn actual size, are available for $1.50 postpaid. Address Fawcett Publications, Inc., Greenwich, Conn., inclosing check or money order. Plan No. 335.

Archery Equipment

[*Continued from page* 104]

tubing about ¾" long over the point. The tubing should be of a size that will fit tightly. A target point made in this manner is shown in *Photo 8*.

Hunting points can be made of thin-walled iron tubing and flat iron measuring 1" wide by 1/16" thick. The tubing should be of a size that will go on the ⅜" dowel stick in a hard driving fit.

Take a piece of the tubing 2¼" long and with a hack saw make two lengthwise cuts three-quarters of an inch long and opposite one another. Then hammer flat this split end of the tube and with a file round off and shape the flattened ends.

Next take a two-inch piece of the flat iron and cut from it an equilateral triangle whose base is one inch and whose sides are a little more than two inches long.

Force the triangle between the flattened ends of the tube and fasten in place with two rivets. *Photo 9* shows the complete hunting tip as well as its two parts. Sharpen the sides of the triangle with a file.

At the other end of the arrow file a nock to receive the bowstring. The nock should be 3/16" deep and just wide enough to grip the bowstring *very tightly* at the section that was served. The nocks can be made with a rattail file, and the nock ends of the arrows should be rounded off with a flat file and sanded smooth. *Photo 10* shows the nock end of an arrow.

Much of the work on the arrow can best be accomplished while it is held in a vise. But the metal jaws of the vise should be faced with wood so that the arrow will not be marked. A good way to make a handy facing is to drill a hole in a block of wood, the hole being a little less in diameter than the thickness of the arrow. Then saw the block in two, centering the saw-cut on the hole. This results in two pieces of wood, each with a half-round groove. When the vise is faced with these two pieces, the grooves grip the arrow well. *Photo 11* shows a pair of these grooved blocks.

After points have been put on the arrows they

[*Continued on page* 166]

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Archery Equipment

[*Continued from page* 165]

are ready for "fletching." Fletching an arrow means fitting it with feathers.

Turkey feathers are excellent for the purpose. Chicken, duck and pigeon feathers can also be used. A poultry market will furnish what is wanted, but should none be available, suitable feathers can be obtained from millinery stores and at the millinery trimming counters of department stores and 5-and-10 cent stores.

Cut the feathers into sections 2¼" long, and then split the quill of each section. See *Photo 12.* Set these pieces, one at a time, in an improvised vise made of two pieces of flat metal and C-clamps. When in the vise no part of the feather should show except the quill. See *Photo 13.* All of the quill must be cut away save a thin strip or sliver—just enough to hold the feather together. The work can be done with a sharp knife or a razor blade, and finished off by rubbing on a piece of sandpaper glued to a board.

The next step is to shape the feathers. For this purpose cut two pieces of sheet metal to the shape shown in *Fig. 4.* Hold the feathers one at a time between these two pieces of metal with the sliver of quill just outside the straight edge of the metal. So held, the metal acts as a guide or template and the feathers can be shaped accurately with a scissors. *Photo 14* shows this work being done.

The feathers are now ready to be attached to the arrows. For this purpose a tube of quick-drying cement of the kind used in making model airplanes is ideal. Three feathers go on each arrow. They are attached an inch and a quarter from the nock end of the staff and are spaced

[*Continued on page* 167]

"I'll run in with the nickel."

Seedlings In Electric Hotbed

[*Continued from page* 127]

ready to plant with seed. Many home gardeners use small hotbeds warmed by use of a battery of eight 25-watt vacuum style B electric bulbs. One man produced thirty plants on an expense of 1c for electric current. A 4'x6' hotbed, placed on the south side of a home, provided space for 100 seeds of 50 different varieties. The soil was prepared in the usual way and the sash placed over it.

The heating unit consists of two strips laid across the top, on the underside of which, on each strip, are attached four 25-watt style B lamp bulbs, connected to an electrical outlet on the back of the frame and extending through the house wall. When the temperature drops below 50 degrees, the thermostat turns on the current.

The top of the hotbed consists of two layers of translucent glass screen, stretched over a wooden frame, the air space between the two layers conserving the heat. With this simple preparation, the hotbed is ready to plant with seed.

This simple hotbed duplicates the sun's effect in a miniature way. By using lamps, the air and top soil within the enclosed hotbed is warmed, and with the covering, practically none of the artificial heat is wasted to any depth in the soil. Illumination from the lamps hastens foliage growth, compared with the old-fashioned hotbed.

The frame of the lamp-warmed type hotbed is made of 1" boards, 8" high 4x6' in area, with earth banked around sides. The rigid top is made of ¾" strips, covered with gelatin wire screen, to form a ¾" air pocket for insulation.

Along the top edge of the box tack a continuous length of wool-fiber weather stripping, to offer a weather-tight seal between the box and the top frame. Hooks should be placed on the sides to hold the top down snugly, especially during cold weather.

Then fasten four lamp sockets to each of the two wooden or metal strips, about 2" wide and 4' long. Starting 6" from either end, space the sockets on 12" centers. Wire with rubber-insulated, all-service cord. Fill sockets with 25-watt B vacuum lamps. Lay the strips on the box just under the weather stripping, about 18" from either end of the hotbed.

Connect the plug of each socket to a weather-proof socket fastened to an all-weather-heavy-duty, rubber-covered extension line leading from the electric outlet. In this line, place the thermostat, of the built-in type, secured at any electric supply store. Warm the soil several hours before planting seed, and you are ready to start the hotbed.

Japan is producing glycerine from hardened sardine oil.

Helping passengers take pictures from the air is just one more duty of the versatile airline stewardess.

Archery Equipment

[*Continued from page 166*]

equidistantly one from another. One of them must be set at right angles to the nock. A great help in getting the feathers on in the correct position is a circular piece of cardboard with guidemarks on it. With a compass draw on a piece of cardboard a circle about two inches in diameter. Then, taking care not to change the set of the compass, strike off six arcs on the circumference of the circle. It will be found that the radius subtends six equal arcs. Draw a line from every other one of the six marks to the center of the circle. Cut a hole in the center of circle large enough to fit the arrow snugly and slip it onto the nock end. The three lines are now an excellent guide for the position of the feathers. See *Fig. 3.*

With the feather held firmly between the two sheet-metal templates, apply cement to the sliver of quill. Hold the feather firmly in place against the shaft until the cement dries hard.

The Target

Archery targets are circular and may be any diameter from two to four feet. The concentric rings, starting with the outer one, are colored white, black, pale blue, red, and a central circle of gold. But there is no reason why an adequate target cannot be made with concentric rings of alternate black and white.

In laying out the target, draw the outer circle first, making it whatever size it has been decided that the target shall be. Then mark off five equal divisions on the radius and draw a circle at each mark. See *Fig. 5.* No matter what the size of the target, the width of each concentric ring is ⅕th of the radius of the outside circle.

The count for scoring:

White	1
Black	3
Blue	5
Red	7
Gold	9

The target backing is best made by twisting straw into a long rope, then forming the rope into a flat coil, or mat, and covering the whole with burlap.

A much less troublesome method is to make or otherwise secure a cardboard box about six inches thick and having a square face large enough to accommodate the target. When such a box is filled with hay, straw, or excelsior, it makes a serviceable targetbacking. *Photo 15* shows a target box being filled with straw. This target has a face two feet in diameter. Target faces can be painted on oilcloth, glazed chintz, or paper. The oilcloth or chintz are best.

Plywood is being made into wall panels as large as 8 by 20 feet.

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(Correct Answers to Quiz on Page 78)

1. False. Storage batteries are direct current only.
2. True.
3. False. A stuffing box is a packed casing used around a propeller shaft or similar shaft to prevent entrance or escape of water or pressure.
4. True. The torpedo might cross the international date line.
5. False. Birds are warm blooded.
6. False. The draw bar pull of a steam locomotive is the same forwards or backwards.
7. True.
8. True. Photosynthesis is a process which takes place in certain plant tissues.
9. False. There are no photographs of Christopher Columbus.
10. True.
11. True.
12. True. A zereba is a type of camp.
13. False. An autogiro cannot climb without a motor.
14. True.
15. False. A back-geared lathe is capable of extremely low speed, and does not run in reverse only.
16. True.
17. False. A double ignition gasoline engine has two sparkplugs per cylinder, and does not necessarily have two carburetors.
18. True. In an increasing turn inside wheels would be turning more slowly than outside wheels, and front wheels would temporarily make a turn of different radius than rear ones.
19. False. Scantlings are the lumber specifications of a boat building job.
20. True.
21. True. It's also called the drive shaft.
22. False. A spiling is a kind of measurement often taken during shipbuilding work.
23. True.
24. True.
25. False. The load is greater.

Attention, MI Readers!

We will pay $1 for each true-false statement which we find acceptable. Statements will not be acknowledged or returned. Address the Quiz Editor, MECHANIX ILLUSTRATED, 1501 Broadway, New York City.

Checks have been sent to the following: Mrs. Wm. Norris, Des Moines, Iowa; John G. Hanna, Dunedin, Fla.; Viris Calkins, Albuquerque, New Mexico; Norman Martin, Mimico, Ontario, Canada; Thomas Mattison, Mpls., Minn.; Miss J. Casey, Comfort, Texas; Childs Berry, Jr., Caruthersville, Missouri; Donald E. Gates, Worcester, Mass.; Stanley H. Baker, Natick, Massachusetts; John H. Spicer, Owen Sound, Ont., Canada; Leslie Thompson, Kansas City, Kans.; Dick Valpey, Petoskey, Mich.; Eugene Nickford, Vancouver, B. C.

About 10 per cent of America's energy comes from water power.

Adjustable Spiling Board

[*Continued from page 125*]

Secure a strip of ½x4-in. oak or other tough limber wood, the longer the better—16 ft. will do for the average 20-footer. Lay off your frame spacings on this or make marks a foot apart using a square to draw the lines truly across the width of the board. The fingers should be roughly double the width of the board in length and of ⅛ to ¼-in. rod or stiff wire, ½-in. of one end of each being bent over as shown. Fasten one atop each line with a staple either end about an inch from the edges of the board driving them only so far as to allow the rods to slide back and forth. The staples act as guides—another clip must be fastened in the center so it can be taken up on to lock the rod in the positions desired. Clips can be made of ⅛-in. or thinner brass shaped so they will crowd the rod when pulled all the way down. Holes are bored in each end; one should take a screw, the other a stove bolt with a wing nut for quick and easy adjustment.

A simpler way is to depend merely on friction to hold the rod, cutting a shallow groove over the lines then using two pieces of brass or heavy tin as clips simply screw fastening each end and crowding the rod so it can be slid back and forth still will not shift of its own accord.

One uses the board like any spiling board. Bend it about the frames so it will touch the other plank or rabbet at one or more points, being sure it does not spring sideways, then clamp or tack it temporarily to a few frames. Run out the fingers which do not touch until they bear against the edge of the fastened plank or the rabbet locking them there or seeing clips do not permit their shifting. Then carefully remove the board to lay it on your planking material so outer tips of fingers work in to best advantage for the planks width or its shape if flitch cut.

Make a pencil mark exactly outside each bent over finger tip then remove spiling board to connect these points up with a single line likely driving brads over each mark to bend the batten to with others against its other side to hold it for marking. Rip the plank roughly outside the mark, then dress carefully to the mark, and when fitted over the frames and pulled down it should be exactly against the already fastened plank; or should fit the rabbet.

The shape of the other edge of the plank is determined in the usual way by marks made on each frame or at every mould to divide these into the same number of spaces. For example, spacings may be 5-ins. amidships gradually working to 3-ins. at ends. These are marked on the plank after springing it in to the frames with its lower edge correct, then it is taken off and these connected with a line for sawing out. With the plank permanently fastened in place the spiling board is set up again to determine the shape of the touching edge of another plank, both sides being carried

[*Continued on page 170*]

Any Rags? Any Bones?

[*Continued from page 39*]

Balboni picked himself out of that crash and looked over his plane that obviously couldn't be made into an operable craft again. Thriftily, he salvaged all the parts of the motor, fuselage, fittings, and accessories that he could, and peddled them to other aviators needing them for repairs or plane improvement. When he figured up, Balboni discovered he'd turned a profit on his "sale," for the $930 he netted was above the pre-crash appraisal of the plane!

So was born the idea for an airplane junk yard, and Balboni soon became known all along the Pacific coast as a likely source for used aircraft parts. He has a wide variety of customers, however—not just other airplane owners. Souvenir hunters come to him for aircraft bits, movie directors have found him an invaluable and inexhaustible source for battered ships to be used in filming crack-ups. Aviation schools abroad have been using salvaged engines in ground-work classes. Hopeful inventors buy discarded, no-longer-operating engines to tear down in their workshops to find a better way to build engines and instruments.

In order to keep his supply plentiful, Balboni is constantly on the alert for news of air accidents. He has little competition, though, when he bids for salvage.

His interest in accidents does not mean Balboni is case-hardened to death due to plane crashes, however. When he hears a flyer he's known has crashed for the last time, he places a cross in red ink in front of the name in his now-famous Gold Book. He used to use an X but says: "Their souls will rest easier with a cross in front of their names, I think." His Gold Book register contains the names of all great flyers and others interested in flying; he started it in 1926 because "a lot of saps didn't believe me when I told them that these famous persons were friends of mine."

Balboni now has a 200-acre airport just east of Ontario, Calif., and a big sign alongside it proclaims BALBONI, CALIF. POPULATION: 1. BUT WATCH ME GROW. Balboni is fond of

[*Continued on page 170*]

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Any Rags? Any Bones?

[*Continued from page* 169]

signs, and has numbers of them in and about his shop and yard, all picturesquely-worded. One says: YOU WILL NOT NEED HANGAR RENT MONEY AT THIS TOWN. YOU CAN PARK YOUR CRATE OUUTDOORS, OTHER SAPS ARE DOING IT. Any major event in his life or in United States affairs is likely to be marked by the painting of another sign for his property. He plans a museum at his "town" of Balboni, Calif., to display parts from famous planes and other relics of interest to flying enthusiasts.

Balboni is an individualist in speech and dress, as the phrasing of his signs indicates, and has become a widely-quoted and -discussed character as a consequence. He wears his "wrist" watch above the elbow invariably and has never been known to wear any outfit, whether at work or dressed up, except knickers and sport shirts. He dislikes the term Mister, insisting, "Balboni, that's all. No Mister stuff."

Outbreak of war has affected Balboni's business, of course, since the restrictions on civilian flying, particularly in the Los Angeles area, have cut down his trade. Too, Balboni now has to get a government permit to remove a wrecked plane from the field where it crashed. Incidentally, he himself no longer flies!

CRYPTORITHMS ANSWERS

Solutions to the problems in the May issue were: No. 13—The Company. No. 14—Heroic Lads.

"Trick" Flash Lighting

[*Continued from page* 99]

directly behind the clay bust on which the subject was working. One other bulb, a No. 2, produced the rest of the needed illumination.

In taking flash pictures, plan the lighting effect you want beforehand, and then set up your bulbs where they will best give the results. Regardless of how many bulbs you may have outside the picture area, one midget bulb properly concealed in the composition will do wonders to your picture by stepping up the contrast and emphasizing your center of interest.

Since the resulting negatives are rather contrasty, it is advisable to develop them in a soft-working, fine grain developer. An ideal developer of this kind is Eastman's DK-20. Also, since you'll probably be working with a tremendous amount of light, it won't be necessary to use ultra speed films, so take advantage of the excellent, slower speed, fine grain panchromatic films available.

All illustrations in this article were made by the open flash method, using Agfa Isopan film, and closing the camera diaphragm down to f/32.

Adjustable Spiling Board

[*Continued from page* 168]

up alternately so a plank for one side can be used as a rough pattern for a matching one on the other.

On longer boats two of these boards may be used, preferably a long one and a shorter one, and clamped or fastened together to be long enough to take off the shape of any plank.

Accurate spiling is necessary to determine plank shapes for any round-bottom boat. And on chine boats the edges of planks at the keel and both sides the chine at least will not fit well or seams look fair unless correctly spiled for. This method is so much faster and more accurate than depending on rule measurements that the time spent making the board is more than repaid on even the simplest job.

When you have completed planking lay the board carefully away as other uses can be found for it throughout construction to determine shape of cabin sides, cockpit coaming, and so forth.

Machine Guards Secrets

[*Continued from page* 146]

Pins driven into the end of a spool make the pinion. They are cut off at $\frac{3}{8}$" and the ends bent in slightly to mesh easily. A $\frac{1}{2}$" section of smaller spool is cemented inside the pins to raise them from the body, and a length of fiber tubing added to the top for a knob. The whole pinion can be slid up the dowel against a spiral spring to disengage the gears.

The dial for the small hand is made of stiff paper, $2\frac{1}{2}$" inside, $3\frac{1}{4}$" outside diameter, and held to the face by three small wire springs. The alphabet is written in a mixed order, and it is upon this order that the secrecy of the machine depends. The one shown was formed by writing the word *Wheatstone*, skipping repeated letters, followed by the rest of the alphabet.

In using the machine, first raise the pinion and set both pointers to a specified pair of letters. Then turn the knob so that the hands move clockwise, until the outer hand points to the first letter of your message. Substitute it by the letter indicated by the short hand. Thus in the drawing, A would be enciphered by O. Continue turning clockwise to the second letter, and so on.

When a double letter occurs in your message, replace the second of the two by Q to prevent confusion in deciphering. For example, the word *recommend* is enciphered as if it were RECOMQEND. Deciphering a message is simply the reverse of enciphering.

The first known artificial eyes were made for Egyptian mummies and statues.

Some new airliner transports have storage for 1,000 gallons of gasoline in the wings.

Fingerprinting A Thunderbolt

[*Continued from page 77*]

The fingerprinting technique applied to lightning inquiry has been serving electrical research like a scout, revealing the main features of lightning years in advance of other methods.

Tools in this thunderbolt "fingerprinting" hardly resemble those the police and G-men employ in recording the ineradicable characteristics of a man, of course. Natural lightning is "fingerprinted" by 182 recording devices installed on buildings, radio towers, smoke stacks, and power lines. Among them are ten recording "eyes": battery-operated cameras attached to fire towers in Western Pennsylvania to measure the amount of current in strokes of lightning, and the number of separate streaks in one thunderbolt and their duration. When lightning strikes a fire-tower mast and jumps a half-inch gap in the camera, the resulting flash is recorded by a film on a revolving disk. Three photographic records of lightning striking these towers were obtained in 1941.

The tool long depended on for measuring lightning is the cathode ray oscillograph, which responds almost instantly to changes in current and voltage, using these changes to move an electron beam and etch a picture of the lightning stroke on a photographic film. It's limited in its ability to record wide ranges of current over a long period of time, however, and has been largely supplanted in use now by the newly-devised fulchronograph, which is sturdier and simpler to operate, covers a current and time range 100 times greater, and costs less than five per cent as much as the oscillograph.

The lightning recording mechanism of the fulchronograph, enclosed in a metal case about 18 inches square, consists principally of an electric motor and a slotted aluminum wheel. The rim of the wheel is filled with small strips of magnet steel projecting like fins and rotating through two coils. The coils carry current from the lightning stroke being measured. Current in the coils produces a magnetic field which is proportional to the surge of lightning current. The steel fin on the recording wheel which happens to be passing the coils at a given instant is magnetized in proportion to the amount of current carried by the stroke, in time divisions as brief as 40 millionths of a second. Characteristics of the stroke may be determined by the number of fins magnetized, and the degree of magnetization. After a storm, tests revealing that magnetization has taken place show whether lightning has struck the building or other object to which the fulchronograph is attached.

The fulchronograph gets its name from the Latin word *fulmen*, meaning lightning, and the Greek *chrono* for time and *graph* for picture. A fulchronograph on a 585-foot smelter stack at Butte, Mont., last summer recorded the most powerful stroke of lightning ever so revealed—

[*Continued on page 172*]

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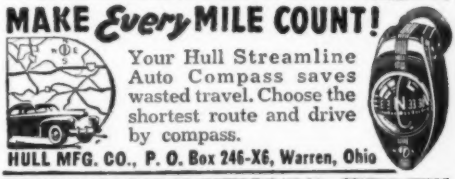
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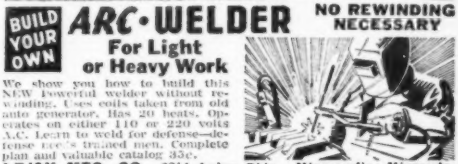
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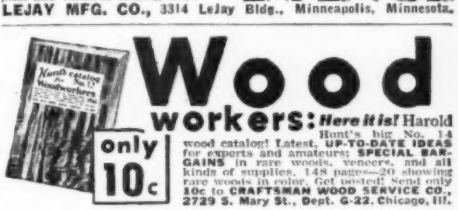
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Fingerprinting A Thunderbolt

[*Continued from page* 171]

a fact indicating again how recent are the discoveries in the field of lightning research. The total amount of current in this one stroke was approximated at 200,000 amperes, a momentary energy of about two and a half billion kilowatts! The researchers hadn't thought so powerful a stroke could occur and had made the fulchronograph's range only 160,000 amperes. That was considered ample in view of the estimate that 15 million volts would be required at the top of the stack to register its maximum. As one result of the giant stroke, the range was at once increased to 200,000 amperes.

Getting into big figures like these makes hard going. Translate the enormity of that biggest-ever thunderbolt like this: if such an amount of energy as that bolt had, could be produced steadily at a gargantuan power plant, that plant's output would be about 57 times greater than the total installed capacity of all this nation's generating stations! It would require generators the same size and capacity as the huge 108,000-kilowatt waterwheel generators (largest ever built in the United States) at Grand Coulee Dam—demanding not six or a score or a hundred, but 23,000 such generators!

But the fulchronograph reveals other facts than the sock of a single giant stroke—another time it showed that a bolt striking the shaft consisted of 22 separate surges, all of them spent in less than half a second. Current in them ranged from 12,500 down to 3,000 amperes. In this stroke, lightning actually struck 22 times in the same place, though to the eye it seemed like a single bolt.

[*Continued on page* 173]

"FORE!"

Backyard Barbecue Kitchens

[*Continued from page* 137]

shown in the drawing, at Section "A." Set the pipes in their respective flues with pieces of wire lath around the bottom. Mortar, plus a few bricks or stones, will hold the pipes in place.

For the final step, build up the back brick wall and the back center wall to the height and shape indicated. Before adding the filling bricking at the top of the chimney, insert a spark grate of ¼" mesh wire.

All that now remains is the grill top and cover on the incinerator. Make the former of ½" rods spaced ½" apart and laid in furnace cement. A sheet of iron can be used for the stove top and another can be used for the incinerator top. A somewhat better way of handling the latter is shown in Figure 6. Two pieces of sheet iron are used with a layer of asbestos between, and the whole riveted together.

By utilizing as much scrap material as possible the cost of this outdoor kitchen can be kept very low and its facilities will be found adequate for preparing real meals, rather than just hamburgers, steaks, etc.—the capacity of the average outdoor fireplace.

MATERIALS NEEDED

300 bricks
7 bags "Brixment"
3 bags cement
Stones, as required
Sand (for mixing concrete)
7 angle iron bed rails
30' of ¾" pipe
25' of ½" round iron rod
Sheet iron for doors and top
Asbestos for top.

Simple Open Fireplace

Those who don't care to spend the time required for building the foregoing fireplace, but nevertheless want some sort of outdoor cooking arrangement, may find the simple grill shown on page 137 exactly right.

There are no frills attached to this fireplace—it consists merely of two low stone walls set parallel on a solid foundation, with grates spanning them for fire and cooking utensils.

The foundation is a six-foot square of flagstone laid upon thoroughly tamped and leveled earth, the cracks mortared. The section immediately beneath the walls was excavated, and a 36" foundation of concrete poured, to prevent any eventual tipping of the walls. (A foundation 12" deep will be sufficient unless the ground is soft or very sandy.)

The flagstones should be about 3" thick.

The walls are three feet long, one foot wide, 18" high, and 18" apart. The inside surface is lined with a layer of brick, since fire cracks rock, and the stone is laid upon and mortared around the brick.

At the top surface three iron rods connect the walls and are mortared into them. Six inches be-

[*Continued on page* 174]

Fingerprinting A Thunderbolt

[*Continued from page 172*]

Both these scientifically-important lightning bolts struck a specially devised trap at Butte: 20 vertical one-inch copper rods, five feet long, mounted atop the tall, 60-foot-diameter stack like a coronet. Each spike is lead-coated to protect it from hot flue gases, and tipped with hard metal alloy so it'll resist destruction as a bolt strikes. Two copper cables connect the ring to the fulchronograph at the stack's base.

A fulchronograph atop the towering University of Pittsburgh building has rewarded scientists with records of seven lightning bolts which have struck the Cathedral of Learning since the device's installation in 1939 when first developed. Knowing the building has been struck so often, fearful persons ask about the danger to occupants of big modern structures of skyscraping type. "Why, they just invite lightning to hit them!" they exclaim. That's right, too. But there isn't a bit of danger to occupants because the steel framework of such buildings acts as a lightning rod. It forms what engineers call a Faraday cage. Everything inside is immune from lightning. That's why you never hear of anyone being killed by lightning in an automobile—the metal auto body forms a perfect Faraday cage about the occupants. A favorite demonstration at the laboratories where lightning bolts are created consists of directing a three-million-volt shot of lightning onto the metal top of a car containing several grinning, unharmed passengers. It's in this laboratory, too, where reproductions of natural lightning are made in determining the duration and intensity of bolts that cause the destruction of a farmhouse or power line breakdown. It's done by scale—with toy-like transmission lines and farm buildings to fit laboratory-size lightning bolts.

Today our knowledge of lightning is especially important in enabling industries essential to the war effort to obtain uninterrupted power and communications. Nearly everyone remembers how service on electrical, telephone, and telegraph wires was shut off perhaps for hours just a few years ago if lines were struck by lightning. Lightning research has guided the plans of arrestors recently so that a properly-designed power line 50 miles long, although hit by lightning 50 times a year, is not likely to be put out of service more than once in five or ten years. That's because present-day protective devices, despite this lightning bombardment, detour all sorts of blazing, sky-splintering bolts harmlessly into the ground. But don't get in the way!

A new "leaning wheel" tire is designed to withstand the wear of carrying road-grading machines along, regardless of whether one wheel is high on a bank and the other down a ditch.

Some new-type life boats are propelled, not by oars, but by hand levers that turn a propeller.

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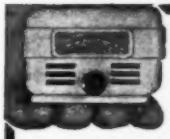

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Vest Pocket Filter Case

[*Continued from page 97*]

the case aside overnight so that the solder may harden properly holding the dividing strips in place.

Cut a piece of felt to the size of the case itself and glue it in place in the lid of the case. Measuring the size of the case rather than the size of the cover itself will insure the cover's closing without binding. Next, cut a number of small pieces of felt to fit into the various compartments of the case, and then glue the pieces in place.

The outside of the case can be given any individual treatment you may desire. If you have examined the illustrations closely and followed the instructions you will be pleased with the neat result. You can be assured that your filters and accessory lenses are well protected and in a single case rather than in five or six small pouches.

The writer's particular case is a fitting companion for his Rolleiflex camera. It contains a "K2" and "A" filter, a set of Proxars for closeups; a Rolleipar prism for parallax compensation, and a Duto soft focus lens. There is also space at one end of the case for lens tissue and a small brush.

Carefully noting the time required to complete the project, the writer found that it could be done in an hour and a half of actual working time. It took 57 minutes to reach the point shown in Illustration No. 5 and twenty-three minutes to complete the padding of the compartments the following evening.

Burnelli Did It First

[*Continued from page 45*]

streaked above the runway, evidently in preparation for an emergency landing on dry ground. Crash cars and fire engines skittered across the field toward the spot where the impending catastrophe seemed about to happen. The mysterious seaplane settled swiftly, lower and lower. A frantic phone call summoned an ambulance just as the pontoons hit the ground. Smoothly and silently, the ship taxied across the field on its pontoons. Spluttering queries from the dumbfounded emergency brigade stopped when the pilot explained it all. "It's one of Burnelli's amphibians—it's got wheels in the pontoons—"

When the first experimental Burnelli transports were getting in stride they were afflicted with a contagious little jinx which the designer himself called "aileronitis." The ship in which Reichers was forced down minus the ailerons was not the only one. On another occasion in the early days, a workman in the plant accidentally rigged the aileron controls backwards. The airplane was prepared to fly to sea to intercept the *U. S. S. Leviathan* 700 miles from New York. The pilot climbed in, took off with tanks full, did a half roll in the air, and landed the big ship upside down. As

[*Continued on page 176*]

Backyard Barbecue Kitchens

[*Continued from page 172*]

low is another set of rods. These rods are for the purpose of holding the grates. Upon the lower grate the fire is built, of wood or charcoal. Charcoal is preferable because of the fine bed of coals it yields quickly, and because it is so clean. Upon the upper grate the steaks are laid to broil. Being only six inches from the coals, they broil quickly, and yet they are not close enough to the fire to burn. The generous width of the cooking surface makes it possible to broil a large number of steaks at a time, or to cook a number of things at one time.

If it is desired to have the fire further from the food, it can be laid directly upon the foundation between the walls, but a close fire makes for efficiency of fuel and of time, and coals are better than blaze.

The mortar used in this construction was mixed with one part cement, one part lime, and five parts sand.

Speed Winding Of Coils

[*Continued from page 126*]

through the legs. A block of wood is cut slightly smaller than the inside of the coil to be wound, and a ¼" hole drilled through it along its horizontal axis. A shaft is made of ¼" round iron and threaded. Welding rod, preferably brass or bronze, is ideal for this purpose. Two washers of the diameter of the outside of the coil are cut from sheet metal.

In setting up Fig. 1, the U is clamped in a vise and the block of wood plus the washers locked on the shaft between the legs by nuts. The spool of wire to be used is placed in a handy location, as shown. A spool on which to wind the coil is made by laying off a piece of fiber or other suitable material, as shown in Fig. 2. The fiber is cut as shown, then folded around the block of wood, Fig. 3. Friction tape is useful in holding the spool in position until winding begins. Accurate check on the number of turns may be had by threading a ¼" rod and connecting it to the jig shaft by coupling A or B shown in the sketch. An indicator is made by drilling and tapping a small piece of strap iron and screwing it onto the rod. The indicator is kept from turning by means of a weight. If the indicating rod is threaded with a standard ¼" die of twenty threads to the inch, each inch the indicator travels will be equivalent to twenty turns of wire on the coil. With a rod of 30" of effective threads, 20x30, or 600 turns may be wound at one time. The rod may then be unscrewed, and turned end for end. This will bring the Indicator back to zero position.—*G. H.*

A 500-pound bomb dropped from a plane flying 200 miles an hour at an altitude of 10,000 feet will hit the earth a mile and a quarter ahead of the spot over which it is released.

Radio Chicks

[*Continued from page 46*]

ourselves supplied with eggs at moderate prices while fulfilling our pledge of an egg or two a week for each Briton.

Radio's use as an egg tester developed from scientists' observations that infertile eggs absorb more radio current than fertile ones. Studies, first made of the yolk and albumen separately, revealed that, as measured by an audio-frequency bridge, the electrical conductivity of fertile eggs decreased while that of infertile eggs increased from the beginning of incubation, in eight out of nine groups.

From this knowledge it was a simple step to establish a radio-frequency circuit that tests the electric characteristics of whole fertile and infertile eggs in much the same way that copper is tested for purity and quality. With such a set-up, Alexis Romanoff and Casper Cottrell of Cornell University discovered that the differences between fertile and infertile eggs were most pronounced at a frequency of 15,000 kilocycles. In their tests, the frequency coil consisted of a variable condenser, inductance coil and a thermoammeter, and was driven by a link-coupled, stable five-watt generator.

Controls in the tests included consideration of the size, weight, and shape of the eggs, all of which were from a flock of white Leghorns chosen for uniformity. Each test egg was put in the coil of the frequency circuit, and the effects of maximum current and resonant frequency observed. Romanoff and Cottrell later made even more precise tests and observations, which bore out the previous conclusions. They found that the conductivity of fertile eggs was a little more than seven per cent lower than that of infertile eggs—sufficient for quick and easy distinction between the good and bad, certainly.

Continuing study of the relative conductivity of the various parts of the egg as well as the whole egg brought about a method of measuring conductivity without having electrodes in contact with the egg. That was good news to commercial poultrymen, especially since it permits study of the intact egg, for the apparatus is not only practical for the task of determining which eggs to incubate, and which should be disposed of otherwise, but was simple and inexpensive to assemble.

Though the radio method of testing eggs' fertility still has a percentage of error, it is accurate in a greater extent than any other existing means. Just when most appreciated, multitudes of dozens of eggs unsuited for incubation will be correctly routed to immediate food and other uses. Clearly, this new benefit of radio should be ranked right up alongside Fibber McGee and Molly!

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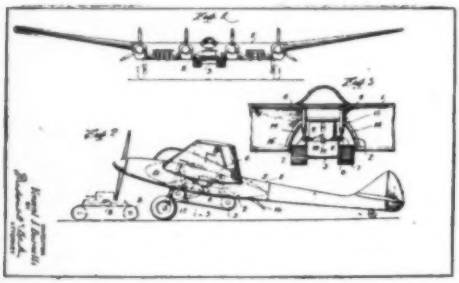
Burnelli Did It First

[*Continued from page* 174]

usual in the event of a crash in these phenomenal ships, the crew members weren't hurt.



Reproduction of the actual Burnelli patent drawing of tank plane. He also has a patent on principle of landing gear nullifying lift of plane during the landing run. This is the same idea used today on tricycle landing gear ships having a slight nose-down position of the wing when wheels are on the ground. Wing then holds wheels firmly to ground and permits better braking. Note view windows in nose of ship above.

But those big broad nosed planes could do some amazing things in the air too, aside from performing unusual feats. Long before the Ercoupe startled the aviation world with its spinproof characteristics, Burnelli did the same type of thing with one of his transports on a demonstration. Clyde Pangborn calmly took it up a few thousand feet, stood it on its tail in a stall, and relaxed. The nose dropped smoothly to normal, and the ship with its cabin as big as a full sized garage, leveled off and flew on.

It was a ship of this type that provided one of the final steps in developing the tank plane idea. It carried a complete 1935 Ford roadster suspended beneath the fuselage. Tiny foreign cars had been hauled this way by other planes, but this one weighed nearly 2 tons, and had the driver in it!

But none of these things is very astonishing to Vincent Burnelli. He didn't just dream up these planes, he went ahead and built them.

In fact, he built the first stressed skin transport plane in the United States—and now they're all built that way.

Today, as the Axis stages a worldwide onslaught against the free peoples of the earth, America must turn to the practical modern pioneers of the air to win the victory. The holocaust which Hitler and his partners loosed upon the world may well become a battle of designers, and we've certainly got the lead on that score. We don't need to spend valuable time testing new ideas and proving that those ideas are practical. We know the ideas are practical because they've been thoroughly tested in the air. The developing work on these flying wing designs has already been done and Burnelli did it first.

Outdoor Refrigerator

[*Continued from page* 139]

fit around the frame uprights inside. Nail these in place with galvanized shingle nails before putting on the metal side-walls. Then nail on the two metal end-pieces, the large back panel, and the metal front panel that fits below top-compartment lid. Next, notch out corners of metal slant-roof back panel at top (as shown) and bend the edges back, or over, to about 45 degree angle, to form lap, or flange, as shown by dotted lines, to fit over top edge of frame properly and to deflect water off—and nail in place on back slant of frame. Then cut proper notches in metal slant-roof front lid, to clear corner frame projections, and bend top flange at dotted line clear back flat on back—and hammer down smooth. This will strengthen the top edge of lid, to which rivet three narrow brass or galvanized hinges. Bend lower edge of lid back to about 45 degrees on dotted line to make nice flush fit over front edge of frame. Set lid in place and screw hinges to top-ridge plate. A small turn-button screwed in center panel, just below center of top-lid, will prevent lid being opened by dogs, and cooler can be left outdoors on cool nights, instead of lowering into well-pit.

Nail narrow wood strip to bottom edge of sheet metal door of bottom compartment, below dotted lines shown. Rivet three similar small hinges on top edge, place door in position and screw hinges through metal center panel into frame (punching holes through metal front to let screws through into the wood). Then fit narrow wood finish strip flush under bottom edge of lower door and nail it in place—put on turn-button to hold door shut—and job is finished except for attaching rope for raising and lowering cooler into well-pit. For this purpose bore a half-inch hole through hand-hold board at top, 4 inches from each end, and attach a piece of stout sash-cord as shown, making knots about every foot to make a good hand-grip. Rounding off edges of the three-inch hand-hold strip at top will make it more comfortable to handle.

These refinements done—the "Cooler" is ready to be loaded with eats for the first descent into the cool air regions of the well-pit—to come up with the butter sparkling with a dew-like daintiness—not too cold, not too soft. The pleasure and comfort of this alone is worth all the labor and cost of your little iceless-refrigerator.

Drive a nail just inside top edge of well-curbing, to hang looped end of rope over, to prevent rope falling into pit. And a hinged platform-cover will facilitate getting into the well-pit to raise and lower cooler.

ANSWERS TO CRAFT TEST ON PAGE 145

1. Drainage P-Trap
2. Nipple
3. Reducing Coupling
4. Tee
5. 3-way Elbow
6. Return Bend
7. Street Elbow
8. Side Outlet Elbow
9. Four-way Tee
10. Running Trap

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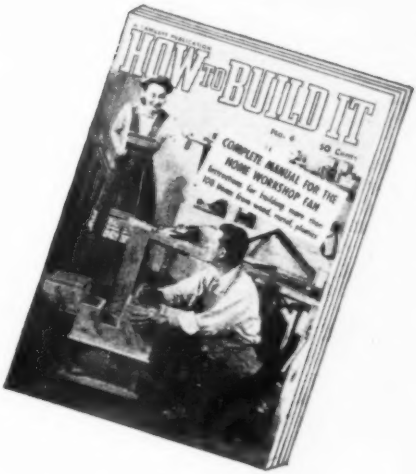

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(CANADIAN ORDERS NOT ACCEPTED)

Civilians Can Fly

[*Continued from page 72*]

fly further than 10 miles from the airport.

This is, admittedly, rather drastic. For ten miles in an airplane is no distance at all. You are literally within sight of your airport at all times.

During the month of January, 1942, I was flying at Rockaway Airport on Long Island. Rockaway Airport is on Jamaica Bay. At the far west end of the bay is Floyd Bennett Field, once a great commercial airport, but now taken over by the Navy. We could not fly in that direction at all, and, in addition, all day long Naval training planes were circling around us checking our NC numbers, and being sure we confined ourselves to our own territory, which was the ocean on the south, the town of Rockaway on the east, and on the north, the opposite side of the Bay. It was like flying over a postage stamp at first. But after a while you got used to it, and never thought about it anymore. Actually in student instruction you never get much farther away than ten miles from your airport anyway.

In addition to the ten mile restriction, there is a new ruling in regard to going cross country.

Formerly, before the war, if you wanted to go cross country you simply piled into your plane and went. Now you must call your nearest airway traffic control station and file what is called "flight information." You do not file, in the strict sense of the word a "flight plan," for that is still confined solely to instrument flying; namely, flying blind in bad weather, in clouds, or above a cloud formation.

"I didn't order a plain malt—take it back and put an egg in it!"

In addition to filing this flight information, which I will describe in a minute, your proposed flight must have the approval of the Army Air Corps Interceptor Command.

But, you say to yourself, all this sounds rather complicated. I'd rather stay home. But you are wrong. In actual practice it is very simple.

Supposing you wanted to fly some Sunday morning from Rockaway Airport on Long Island, over to Bendix, New Jersey, then back over the Hudson river to Armonk, in Westchester county, New York. At Armonk you would land, have a coke or a cup of coffee, stretch your legs, and talk with the "boys." Then you would pile into your plane and fly back to Rockaway, passing by the great La Guardia Airport.

To do this, before you left you would file your flight information by calling a Newtown phone number (the airway traffic control at La Guardia) and say:

"I'd like to file some flight **information** please."

"Okay. Go ahead."

"The flight will be made in a Piper Cub, NC 35877. Pilot's name is Barnes."

"C. F. R.?" airway traffic control would say.

"Yes. C. F. R." (Contact flight rules.)

"Any radio?"

"No radio. I'm leaving from Rockaway Airport, going to Bendix, New Jersey, then to Armonk, and return. Cruising altitude 2,000 feet, cruising speed 70 miles an hour. I'm leaving immediately, and I expect to be gone three hours."

"Okay, Mr. Barnes, just a minute."

In a second he would be back.

"All right, Mr. Barnes. Your flight plan has been approved by the First Interceptor Command. It will be void, however, unless you leave the ground in ten minutes. That's Q. V. Q."

"Thank you."

And you'd hang up. His last remark Q.V.Q. meant that you would *not* have to report to him your return to Rockaway. On a regular flight plan on instrument of course, you would have to call him immediately upon landing.

Your conversation would have taken maybe five minutes. And then you would takeoff on your flight, with no one to bother you, as free as the air itself. And that despite the fact that the country is at war.

In addition to these few simple rules, there are one or two others that existed before war was declared. The air above 17,500 feet, for instance, is barred to all civilian aircraft, even those flying the airlines. The air above 17,500 feet is reserved for the armed air forces of the United States.

Another rule is that all the air above 3,500 feet is barred to civilian aircraft unless they are equipped with a two-way radio and a sensitive altimeter.

Restrictions? Of course there are restrictions —but none to which any true and loyal citizen could object.